1   RI2000 EMISSION INSPECTION SYSTEM SPECIFICATIONS

1.1 Background Information

RI has adopted regulations that change the emission and safety test used in the present inspection/maintenance (I/M) program. The analyzer approved to implement this program is called the RI2000. This document details the specifications for the RI2000 inspection systems that include:

- ✓ Transient mass emission testing
- ✓ Two speed idle testing
- ✓ Safety testing
- ✓ Diesel non-loaded
- ✓ Diesel loaded testing

1.2 Organization of Specification

This document provides the specifications for the RI2000 equipment and procedures to be used for performing inspections required by RI regulation and legislation.

Section 1	This section is an introduction, providing background about emission testing equipment. System security and integrity are also included in this section.
Section 2	This section gives the specifications, including performance standards, for all test-related hardware such as the computer, the analyzer, the dynamometer, the fuel cap tester, the analyzer cabinet, and bar code scanner.
Section 3	This section describes in detail the software specification, including data storage; the form, manner and frequency of electronic transmission including transmission of test, calibration and vehicle records, sequences and procedures for performing required tests.

The Appendices contain items referred to in the Specification. The following is a list of all appendices:

Appendix I	Data File Information, File Layout and Format
Appendix II	Example forms including Windshield Sticker Layout, Vehicle Inspection Report (VIR), Diagnostic Trace Report, Diagnostic Text Report, and Vehicle Repair Report Form
Appendix III	Drive Cycles
Appendix IV	ATP (Reserved)
Appendix V	Bar Code Format Definition (Reserved)

Appendix VI   List of names and abbreviations of the 50 states, District of Columbia, Puerto Rico, Guam, American Samoa, Mexico, Canada, Armed Forces Plate, etc.

1.3 Users

The RI2000 shall be used by users that have either an approved license and access code or a password that allows entry to specific functions.

~~1.1.1~~1.3.1   Inspectors

The Inspectors shall be allowed to perform inspections, calibrations, and other functions outlined in Section 3. Each Inspector shall have a unique password and license number combination.

~~1.1.2~~1.3.2   State/QA

The QA/Staff Representative shall be allowed to use the QA/State functions outlined in Section 3. ~~The QA/Staff Representative password shall be based on a confidential daily-changing algorithm, to be provided by the Program Administrator in a separate document.~~Each QA/Staff Representative shall have unique password and license number combination. The QA/Staff cannot conduct an Inspection through the Main Menu.

~~1.1.3~~1.3.3   FSR

The Field Service Representative (FSR) shall be allowed to use the FSR functions outlined in Section 3. The FSR password shall be based on a confidential daily-changing algorithm, to be determined by the RI2000 manufacturer. The FSR cannot conduct an Inspection.

~~1.1.4~~1.3.4   Station Manager

The Station Manager shall be allowed to use the Station Manager functions outlined in Section 3. Each Station Manager shall choose a password. The Station Manager password cannot be used to conduct an Inspection.

1.4 Electronic Transmission

1.4.1 Electronic Transmission (ET) Overview

A required component of the enhanced program is the electronic transmission of data, i.e. information about the vehicle under test and the test results. Electronic Transmission (ET) is the name that the Program Administrator has given to the electronic network that enables the RI2000 to automatically connect to RI's centralized Host Computer System (HCS) via a modem and dial-up connection.

a   Mandatory ET Service:

In order to comply with the ET mandate, each inspection station shall obtain and maintain ET services through RI's designated ET contractor. The following criteria shall be met before an RI2000 is used for I/M test

certification:

>> 1   The RI2000 shall be connected to, and shall be fully functional with the ET service.

>> 2   The RI2000 shall possess, and be operational with the current software or hardware update.

> b   *ET Service Description:*

At the beginning of the test, following the Inspector's entry of the Vehicle License information, sticker, and VIN into the RI2000, the ET software (via the modem and dial-up connection) will initiate an automated call (initial call) to the HCS.

Data is transmitted electronically to the HCS during the next call (at the beginning of the next test, XX minutes after the last test (~~XX is configurable via the HCS~~Network Dialup XX Minutes After Test in NETWORK.DAT), or during a nightly call-up function, etc.). Using the ET system, the Program Administrator is also able to send electronic messages to Inspectors and stations.

Details of the ET system are found in Section 3.

> c   *Debit Transaction Authorization:*

The RI2000 shall have the ability to initiate orders to purchase test authorizations

The HCS shall initiate an ACH (Automated Clearing House) debit transaction from the station owner's account. Upon completion of this transaction and verification of the account, the HCS shall issue authorizations to the analyzer per the ET protocol.

> d   *Charges for ET Services:*

Inspection stations must maintain ET service in accordance with the terms specified by the contract between Keating Technologies, Inc (KTI) and the station owner.

> e   *Communication Protocol*

The RI2000 manufacturer will be required to work in cooperation with the ET contractor and KTI to finalize development of a communication protocol.

~~1.1.2~~1.4.2   *Form, Manner and Frequency of Data Transmittals for ET*

> a   *Form*

For each inspection, the data transmittal shall consist of the vehicle's inspection record and, when required, calibration record(s) and other records (as defined in the communication protocol).

> b   *Manner*

The manner of the data transmittal shall be using the RI2000 modem via a

dial-up connection. The RI2000 must be maintained to ensure proper operation and shall be connected to a fully operational dial-up connection.

c   *Frequency*

RI2000 data shall be transmitted as described in Section 3. The RI2000 shall include at least one attempted transmission per inspection.

1.5 Tamper Resistance

Controlled access design shall be the responsibility of the manufacturer. All security measures shall be submitted for approval by the Program Administrator. With the exception of approved software updates performed by the manufacturer's representatives, the RI2000 shall prevent, to RI's satisfaction, all users from creating or changing any test results, RI programs or RI data files contained in the RI2000 as called for in this specification. Manufacturer shall utilize special BIOS, partitions (or equivalent approved by the Program Administrator) as well as other appropriate software and hardware provisions deemed necessary by the Program Administrator to protect the I/M files and programs. File and program protection may consist of mechanical systems in combination with electronic/software systems. The protection features shall prevent access to the secured disk drives and portions of the hard disk containing I/M programs and test data. Access to the OS or BIOS shall not be available to any and all users. The manufacturer may propose other security or protection alternatives, such as more sophisticated BIOS limitations and LPT port key, for approval by the Program Administrator.

In addition, the emission analyzer, sampling system, VMAS, sticker printer, cabinet, and PC shall be made tamper-resistant to RI's satisfaction. Also, the analyzer shall have a solenoid lock to secure the state floppy drive door. As a minimum, the manufacturer shall develop tamper-resistant features to prevent unauthorized access through the cabinet. Microswitches, keyed locks, software-controlled locks, and software algorithms requiring the use of an access code shall all be utilized where appropriate. The manufacturer may utilize a combination lock on the doors securing the disk drives as long as the locks are built-in, good quality and authorized personnel can easily change the combination when a security problem is identified. The following examples illustrate ineffective - and therefore unacceptable - security measures: a mercury switch would not be effective if the analyzer can be tipped over to one side to trigger the switch, a keyed lock would not be effective if it is placed in a position that allows the analyzer cabinet to be flexed slightly to bypass the lock. If there is a dynamometer control cabinet separate from the secured area of the analyzer cabinet, it shall be secured in a manner approved by the Program Administrator.

The Inspector shall have access to the required compact disc (CD) drive. However, access security to the BIOS, I/M related programs and data must be secured from this drive when accessed by an Inspector. The manufacturer shall provide security for the CD drive to prevent unauthorized read/writes (to memory, ROM, hard drive, etc.). This security shall guard against unauthorized

executables that are executed from the CD. The manufacturer shall submit their method for providing this security to the Program Administrator for approval.

A software-controlled solenoid lock shall be used on the secured drive door of all RI2000 units submitted for certification. This solenoid lock may be used instead of, or in addition to, any key or combination lock that may be provided. The solenoid lock shall be controlled by the RI2000 software, unlatching the doors in response to authorized requests from the STATE MENU, always maintaining the appropriate levels of security. All RI2000 units shall have sensors, such as microswitches, to detect the open/closed state of the doors, as well as other secured areas of the RI2000. The RI2000 shall monitor these sensors and shall define an inappropriate state as a tamper.

The the manufacturer may offer analyzers with additional disk drives that can run optional software application programs. However, the optional disk drives shall be secured from the BIOS, operating system and all other I/M related programs and test data (or equivalent acceptable to RI).

If tampering occurs, a software lockout algorithm shall be activated which aborts any existing test sequence and prevents further I/M testing until the lockout is cleared by a QA/State representative or an FSR.   In addition, the manufacturer must describe, to RI's satisfaction, what security measures will be taken to prevent the unauthorized use of access codes, keys and combinations to the secured areas of the analyzer under each of the following circumstances:

> 1   Tampering has occurred.
>
> 2   A manufacturer's field service representative quits or is fired.
>
> 3   A combination, key or critical access code is obtained by an unauthorized person(s) such as an inspector.

Aside from a software update, neither RI field representatives, nor other representatives authorized by RI such as QA inspectors, nor manufacturer's field service representatives shall be able to modify files on the hard disk. At no point shall Inspectors have access to the BIOS.

The use of microswitches to detect unauthorized entry is acceptable. However, unauthorized access to the secured areas of the analyzer shall be detected even when the power is off.

The lockout system shall be designed so that it can be activated by an RI field representative from the STATE MENU. Only RI field representatives (or other representatives authorized by RI) or the HCS may remove lockouts put in place from the STATE MENU. The manufacturer shall develop a system by which their field service representatives shall be prevented, by some method approved by RI, from clearing RI installed lockouts.

In particular, the following policies shall apply to the the manufacturer's field representatives:

> 1   They shall <u>not</u> be capable of:

     i   clearing a State/QA-installed lockout, or

     ii   clearing a lockout due to a requirement for a calibration.

2   They shall not add, delete or modify Inspector license numbers.

3   They shall not be capable of altering the calibration gas values.

4   They shall not clear a lockout when there is evidence of physical tampering.

The tamper resistance features shall be designed so that software programs, especially those that deal with repair and diagnostics of vehicles, can be added at a later date.

Optional software packages supplied by the manufacturer shall not interfere with the normal operation of the I/M inspection and testing software, shall not compromise the tamper-resistance of the analyzer (such as giving the Inspector access to the OS), and shall be approved by the Program Administrator before they are delivered or installed in any RI2000 analyzers.

Access to and from all required and mandatory-option programs shall be "seamless." These programs shall be accessed from the Main Menu or a submenu, and, when exited, shall return directly to the menu or submenu from which they were accessed, without requiring the RI2000 to reboot.

2 HARDWARE SPECIFICATIONS

Section 2 discusses the hardware performance requirements (and design requirements where necessary) for the State of Rhode Island Analytical and Safety System (RI2000).

~~1.1~~2.1 Overview

This section covers the computer and its peripherals, the emissions analytical train and its sample conditioning system, the dynamometer, the cabinet and the hardware aspects of its security, bar code scanning, engine speed measurement, and other equipment.

The RI2000 comprises an IBM-compatible personal computer (PC) with a Vehicle Inspection Report (VIR) and sticker printer, modem and software to perform both transient and two-speed idle testing, five-gas analyzer and sample conditioning system, zero and calibration gas inlet hoses with fittings, dynamometer, dynamometer control interface, engine cooling fan, bar code reader, fuel cap tester, tachometer, OBD-II device, opacity measurement system (optional) and cabinet.

~~1.1.1~~2.1.1   Computer/Peripheral Compatibility

Computers shall be IBM-PC-compatible. They shall be able to reliably read

and write IBM-compatible 1.44Mb 3.5" diskettes.

Systems must be capable of producing graphic output on CRT displays and printers. The computer and printer shall be capable of printing graphics and text displayed on CRT.

Systems must be capable of communicating with computers using modems and a dial-up connection. The power supply must have the potential to handle at least 100 watts of additional upgrade devices.

~~1.1.2~~2.1.2   *Workstation Configurations*

Systems shall have multiple configurations depending on the vehicles a station plans to inspect. The table below lists the basic workstation configurations:

EMISSIONS TEST EQUIPMENT	VEHICLES TO BE INSPECTED	RI2000 HARDWARE CONFIGURATION
TRANSIENT LOADED MASS, TWO SPEED IDLE, OPACITY (LOADED, NON-LOADED ACCELERATION	ALL VEHICLES	1
TRANSIENT LOADED MASS, TWO SPEED	ALL VEHICLES EXCEPT ALL DIESELS	2
TWO SPEED, OPACITY (SNAP ACCELERATION)	ALL VEHICLES THAT DO NOT REQUIRE DYNO TESTING	3

The system hardware design must allow field retrofits to upgrade or downgrade hardware configuration without obsoleting present equipment. This may require the secured areas of the system such as computer/boards to be updated.

The following table describes the equipment to be included in the workstation configurations:

Description	1	2
PC Computer System	YES	YES
VIR and Sticker Printers	YES	YES
Anti-Tamper Cabinetry	YES	YES

~~Barcode Reader System~~	~~YES~~	~~YES~~
~~2-Speed Idle Analyzer w/ Contact and Non-Contact RPM~~	~~YES~~	~~YES~~
~~VMAS~~	~~YES~~	~~YES~~
~~Smoke Opacity Analyzer~~	~~YES~~	~~NO~~
~~Dynamometer~~	~~YES~~	~~YES~~
~~OBD-II~~	~~YES~~	~~YES~~

Description	1	2	3
PC Computer System	YES	YES	YES
VIR and Sticker Printers	YES	YES	YES
Anti-Tamper Cabinetry	YES	YES	YES
Barcode Reader System	YES	YES	YES
2-Speed Idle Analyzer w/ Contact and Non-Contact RPM	YES	YES	YES
VMAS	YES	YES	NO
Smoke Opacity Analyzer	YES	NO	YES
Dynamometer	YES	YES	NO
OBD-II	YES	YES	YES

A wireless remote is required with all configurations.

The RI2000 system shall permit testing only if the system configuration is appropriate for the test required.

~~1.1.3~~2.1.3 Owners Manual

An owner's manual must be supplied with every unit. Replacement manuals must me made available to the shop, at a reasonable fee. Manual releases that correct manual errors or that reflect changes to the workstation hardware or software shall be supplied at no additional cost.

At a minimum, the manual must list the following safety check points:

- The use and availability of wheel chocks and tie straps at the station are mandatory safety essentials.

- Customer must exit vehicle prior to entering inspection bay.

- Customer will not be allowed to enter inspection bay during test.

- No employees, other than inspector, will be allowed into the bay

while vehicle is driven on the dynamometer.

- Inspector must stay in the driver's seat at all times during the dynamometer test, using the hand held remote control unit to make computer entries.

- Inspector/employees must never walk on the rolls.

- Inspector/employees must never pull on the drive belt in order to spin the rolls.

- All accessories (i.e. radio, air conditioner, etc.) will be turned off by inspector.

- Vehicle will be inspected for exhaust leaks. Vehicles with leaking exhaust systems will be rejected from testing.

- Vehicle will be inspected for fluid leaks. Vehicles with leaking engine oil, transmission fluid, or coolant will be rejected from testing.

- Vehicles with obvious mechanical problems (i.e. engine, transmission, brakes or exhaust) that could create safety hazards will be rejected from testing.

- Vehicle will be at normal operating temperature prior to the start of the test. The vehicle temperature gauge, if equipped and operating, will be checked to assess temperature. Vehicles in overheated condition will be rejected from testing.

- Vehicle will be rejected from testing if tread indicators, tire cords, bubbles, cuts, or other damages are visible. Vehicle will be rejected from testing if it has space saver tires or if it does not have reasonably sized tires on the drive axle.

- Exhaust evacuation hoses will be placed over exhaust and directed outside of enclosed bay.

- Vehicle will be maneuvered onto the dynamometer with the drive wheels positioned on the dynamometer rolls. Prior to test initiation, the rolls will be rotated until the vehicle laterally stabilizes on the dynamometer. Vehicles that cannot be stabilized on the dynamometer will be rejected from testing. Drive wheel tires will be dried if necessary to prevent slippage.

- Testing will not begin until the vehicle is restrained. Tie downs must be used and chocks must be placed in front of stationary wheels.

- All manufacturer-recommended safety guidelines will be followed.

- Call equipment service staff for any operational problems.

2.2 General Requirements

Alternatives to the specified RI2000 system shall be approved by KTI.

1.1.1̶2.2.1 *Availability of Circuitry*

All components including circuit board and integrated circuits used in the RI2000 shall be types and brands that are presently in common usage. Custom ROM programs developed by the manufacturer for building the analyzer are allowed. Rhode Island may allow deviations upon approval.

1.1.2̶2.2.2 *Clock/Calendar*

The RI2000 shall have a real time clock/calendar that shall make available the current date and time. Both time and date shall be in standard IBM PC format and used to set the computer's date and time on power up.

The communication software shall reset the current RI2000 date/time settings each time contact is made with the HCS except during communication diagnostics. The RI2000 clock shall be reset to the HCS clock at the beginning of each test.

The analyzer clock/calendar shall be equipped with a battery backup feature that has a battery with at least a five-year expected life. The calendar shall handle the year rollover from 1999 to 2000.

1.1.3̶2.2.3 *Data and File Transfer*

All required RI2000 files, per Data File Summary, shall be capable of being transferred from the RI2000 in two ways:

a   *Via an IBM PC compatible modem (located inside the cabinet) and connection to a telephone line, electronically receiving and/or transmitting data from the HCS whenever the RI2000 connects to the HCS.*

b   *By use of the standard 3.5" IBM 1.44Mb compatible floppy disk on which data is stored.*

2.2.4 *Capability to Access OBD Fault Codes*

(Note: OBDII functionality will be deferred until six months after program start date.)

The RI2000 shall connect to the OBD-II SAE Standardized Port on the vehicle. The RI2000 shall access engine RPM, readiness codes and fault codes for all OBD-II equipped vehicles.

1.1.5̶2.2.5 *Analyzer Compatibility*

The RI2000 shall be compatible with all types of automotive service operating environments. The analyzer shall operate under the conditions and performance requirements of this specification.

1.1.6̶2.2.6 *Testing Throughput Capability*

The emissions analyzer shall be designed so that it is capable of performing at least 10 tests per hour for eight consecutive hours for any test defined in this specification without experiencing excessive hang-up or

other deleterious effects.

1.32.3 Computers & Peripheral Requirements

An IBM PC-compatible computer shall control the RI2000 functions. Each RI2000 must include the hardware and software needed to perform all functions required by this specification. The computer shall be capable of at least the following tasks:

a   *Collect, operate on, and record second-by-second mass or concentration readings for HC, CO, CO_2, O_2, NO, dynamometer speed and load, engine RPM, etc. The computer shall also collect OBD fault codes, gas cap readings, safety data, etc on a per test basis.*

b   *Monitor and control dynamometer functions.*

c   *Transmit test and calibration records to the HCS.*

d   *Read and interpret bar code labels from vehicle inspection sticker, Inspector licenses, gas bottles and VIN labels.*

e   *Read data from compact discs (CD).*

f   *Provide storage for archived test and graphic files.*

g   *Access engine RPM and fault codes on OBD-II equipped vehicles.*

h   *The RI2000 must be able to recall as well as provide VIR reprint capability for at least the latest 1000 test records in addition to any tests performed in the past 60 days.*

i   *Interface with an optional partial-flow opacity-measuring device, display and record to the test record.*

j   *Interface with KTI's statistical diagnostic messaging system.*

Rhode Island reserves the right to add additional programs and functional performance requirements, up to the technical limits of the hardware, to improve the I/M program.

The manufacturer may offer analyzers with additional disk drives that can run optional software/hardware application programs; however, the computer shall not allow any program run from one of these drives to have access to the computer's operating system. Programs run from an additional drive shall not be capable of interfering with, modifying, corrupting or interrupting any inspection-related program, procedure, or file.

1.1.22.3.2   *Minimum Required Microcomputer Configuration*

a   *Operating System*

Each unit must be supplied with an IBM PC-compatible, multi-tasking, operating system, which provides TCP/IP capability such as OS/2 connect or an MS Windows variant.

b   Processor

The processor shall be IBM PC-compatible. Processing speed shall be equivalent to, or faster than, a computer equipped with an Intel Pentium 100MHz. The motherboard shall have an industry standard, easily replaceable processor.

c   RAM Memory

The system must contain at least 16Mb of user-available RAM and must be expandable to at least 128Mb.

d   BIOS

The system must include a ROM BIOS (basic input/output system) that provides a self diagnostic routine to check the performance of critical PC components (including, as a minimum, the processor, firmware, ROM, hard disk, keyboard, clock, set-up RAM and memory) upon power and which enables full use of the operating system. These BIOS must fully support all supplied components.

e   Cache Memory

The system must contain at least 256K of external cache memory. If more than one processor is used for the central processing, then for each additional processor, 256K more cache memory must be added.

f   Bus

When equipped with all Rhode Island specified options, each unit must provide two slots for future expansion, include at least 1 free PCI slot for future expansion. The PCI expansion slot or slots must be fully PCI-compliant ("plug-and-play") and be capable of mapping IRQ 14 & 15. If the video or hard drive interfaces are provided by the motherboard, it shall be capable of being disabled.

g   Monitors: Display Screen & Drive Trace

The active screen area must be in color, of .28 dot pitch or less, and measure at least 14" diagonally. The monitor must be capable of non-interlaced resolution up to 1024 X 768. The display must interface with a color graphics adapter fully compatible with the IBM SVGA color graphics adapter. This interface must be capable of operating in non-interlaced modes up to a resolution of 1024 X 768 while emulating 64K colors or more. The video adapter must be equipped with a 64-bit accelerator chip (or better) to increase its video processing speed and must be PCI bus-compliant. The video adapter must be easily upgradable to at least 2Mb if not already equipped with 2Mb.

The above specifications do not apply to a second portable monitor that may be provided for the driver. However, this monitor must display all warnings and information required to perform the driving portion of the test

(RPM, drive trace, etc.). This second monitor is subject to Rhode Island's approval.

A screen saver shall be provided for the monitor(s).

h   *Floppy Disk*

One 1.44Mb floppy drive is required. The floppy drives must have an external door protecting them from contamination (dust). The analyzer's cooling fan (if equipped) shall not create a negative pressure in the case unless the floppy drive(s) are sealed to prevent this negative pressure from drawing dust into the drive. The secured floppy disk shall be designated the "A" drive.

i   *Compact Disc (CD)*

Each analyzer must be equipped with one 32x (minimum) CD-ROM drive. The disk drive must be protected from contamination in the shop environment. The CD-ROM drive shall be capable of reading CD-ROMs that are formatted per ISO 9660. The CD drive shall be designated the "H" drive. The minimum acceptable sustained average random access time of 225ms and must be multimedia and photo CD compatible as a minimum. A means for providing security to prevent unauthorized access to lower level system functions shall be submitted by the manufacturer for KTI's approval.

j   *Hard Disk*

Each unit must come with at least 1.6 gigabytes of usable formatted uncompressed hard disk storage. The vendor must leave at least 1.2 gigabytes of usable storage for Rhode Island and 150Mb of graphic/audio and text storage allotted to the Inspector. Second-by-second data, emission inspection data (including graphics) and vehicle data will be stored in the Rhode Island storage area. The system shall warn the Inspector with a screen prompt when the hard disk is within 10% of being full in any of the allotted storage areas. The hard disk is to be self-parking, shock mounted, and able to operate reliably in the expected hostile garage environment. The hard disk must also include a Rhode Island-approved method of limiting logical access to Rhode Island's data and programs. The hard disk containing Rhode Island programs and files shall be designated the "D:" drive. The hard drive's minimum acceptable burst transfer (external transfer) shall be 7,000 kilobytes per second. The hard drive's minimum acceptable sustained transfer (internal transfer) shall be 2,000 kilobytes per second. The minimum acceptable average random access time shall be 14ms. No software cache can be used when measuring transfer rate or access times.

k   *Hard Disk Interface*

The hard disk interface must be PCI bus-compliant and use enhanced IDE Mode 4 (or better) or Fast SCSI-2 (or better) or alternative approved by Rhode Island. The hard disk interface must be capable of maintaining a

minimum transfer rate of 8,000 kilobytes per second with all peripherals installed (including options).

I   I/O Ports

The unit must include at least two DOS/IBM compatible parallel printer ports. The parallel ports must be enhanced bi-directional.

The unit must include at least one free (Rhode Island-reserved) male DB25 (25-pin) baud-rate-programmable (300 to 115.2K or more) IBM PC RS232C-compatible serial ports with full hardware support. This port must be unpopulated, easily accessible, for future expansion if authorized by Rhode Island.

Three baud rate programmable (300 to 115.2K or more) I/O serial ports using CPC female connectors with the following pin-outs must be provided. One of these ports is for use with an external fuel cap tester (unless the fuel cap test system is provided internally). Two of these ports are to be free (Rhode Island-reserved) for future expansion or for use by the manufacturer upon approval by Rhode Island.

All Rhode Island-reserved serial ports (CPC and DB25) shall use 16550 UART chips or better. All I/O ports shall be clearly labeled and easily accessible and may be shared. All CPC pin-outs shall be as follows:

ANALYZER CPC REVERSE CONNECTOR

This connector must be compatible with an AMP 211398-1.

PINS	**SIGNAL**
1	GND
2	+12v
3	RTS................RESET (request to send)
4	RESERVED (open)
5	SHIELD - GND
6	TXD.............. TRANSMIT DATA
7	RCV...............RECEIVE DATA

The CPC ports will supply software switchable 12V DC to equipment attached. The +12V pin must provide circuit protection from shorts, or overload. The circuit protection can be in the form of a fuse, circuit breaker, etc. The circuit protection must be easily accessible to the operating technician for fuse replacement and or circuit beaker reset (unless automatic reset). The circuit must be capable of handling at least 6 watts per connector.

CPC CONNECTOR DIAGRAM
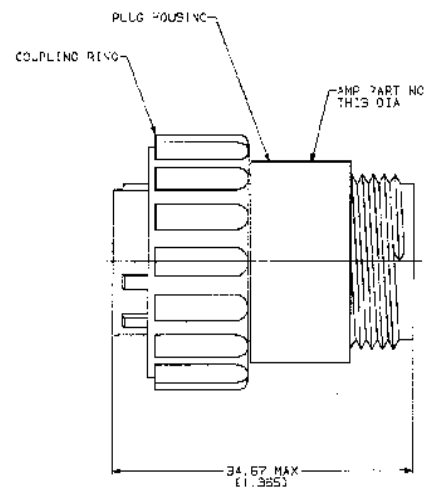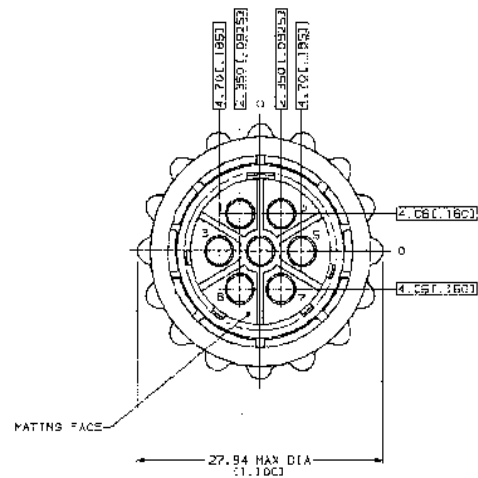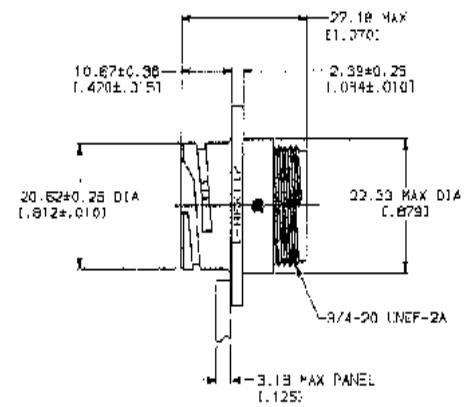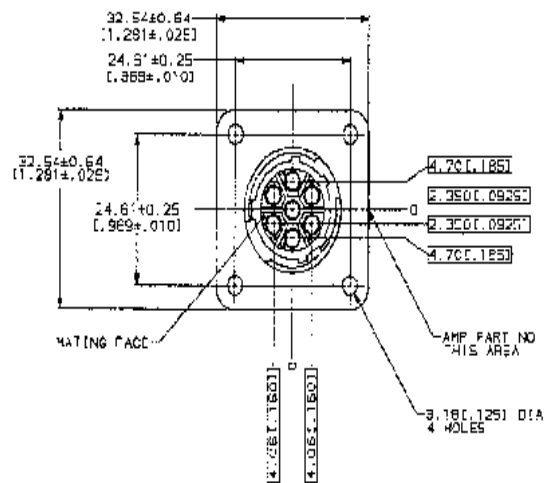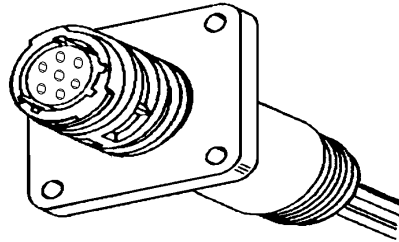
~~1.1.3~~2.3.3 Input Devices

a   *Keyboard and Pointing Device*

The RI2000 keyboard must be fully interfaced with the microcomputer and have all of the necessary normal, numeric, cursor, control, shift, alternate, and function keys needed to operate a standard IBM PC-compatible computer. A full-sized keyboard with at least 101 keys should be provided. The keyboard shall be readily available through retail outlets. The keyboard shall be removable and replaceable without requiring access to a secured area within the RI2000 cabinet. The keyboard must accept a standard keyboard connector. Provisions for a pointing device must be provided. If not built in, then a common connector (PS2, DB 9-pin, etc.) must be provided. The device driver must be active and compatible with an MS Mouse. The pointing device must have a sensitivity adjustment available to the Inspector. Rhode Island may approve other pointing devices (such as light pens).

b   *Wireless Remote Control Input Device*

A wireless input device shall be provided with each RI2000. The device shall have at least 3 input buttons, each labeled with a number clearly. The button labels shall be integrated into the software prompts.

In the safety test, the choices for the buttons shall be 1) Pass, 2) Fail, and 3) Not Applicable. In addition, the remote input device shall be used in opacity testing.

The remote shall be equipped with a means of allowing the driver to start the test, perform an emergency stop, and perform other necessary and convenient functions related to the test, while inside the vehicle.

If multiple RI2000 units are used in the same area, the signal from one unit shall not interfere with or be interfered by the other units.

A belt clip shall be provided with each unit.

c   *Bar Code Reader*

The RI2000 shall detect the presence of the bar code scanner automatically at POWER ON. The bar code reader at a minimum shall:

- Read VIN from windshield

- Read bar code on audit and calibration gas bottles

- Read RI2000 inspection sticker

- Read Inspector License

For additional details on the BAR Code Reader specification see the Bar Code Scanner section.

~~1.1.4~~2.3.4   *Modem*

The modem hardware must support the following protocols:

- Modulation: ITU (International Telecommunications Union, formerly the CCITT) V.22, V.22bis, V.32, V.32bis, V.34.

- Error control: ITU V.42, MNP (Microcom Network Protocol) 2, 3 and 4.

- Compression: ITU V.42bis, MNP 5.

- Connect Time: The modem must be capable of achieving a link with the HCS in less than 10 seconds at 28.8K baud or higher. The link time will be measured from the point the line is picked up to the point of connect.

The modems must support at least the following baud rates: 1200, 2400, 4800, 9600, 12k, 14.4k, 19.2k, 21.6k, 24k, 26.4k, 28.8k asynchronous operation.

The modem must support the industry-standard AT command set.

If the modem is not using a common expansion bus slot or a common I/O jack (such as a modem that is an integral part of the motherboard), then a means of disabling the modem and an expansion slot or another high speed I/O port must be provided with the intent of supporting an upgraded modem if needed for future expansion.

The RI2000 shall reinitialize the modem if three complete vehicle inspection tests are run without one successful communication with the HCS. The RI2000 manufacturer shall submit their re-initialization methods to Rhode Island for approval.

The modem lights (if equipped) shall not be visible to the I/M Inspector. The speaker shall remain off at all times and may not be turned on except for manufacturer or diagnostic testing. The manufacturer shall submit a plan for modem diagnostics for approval by Rhode Island.

The analyzer shall have a standard female modular telephone connector located on the back of the analyzer. The telephone cord shall not be attached to the power cord. The telephone line shall be enclosed in a protective cable meeting Rhode Island and UL approval. Alternative methods may be submitted to Rhode Island for approval.

~~1.1.5~~2.3.5   **Printers**

a   *VIR and Diagnostic Printer*

The RI2000 unit shall use a laser printer capable of printing at least 4 pages of text per minute, on 8.5" x 11" paper, at 96 characters per line, and 6 lines per inch. This printer will be used to print inspection reports

and diagnostic information. The printer must print high-quality graphics at 600dpi or better. Text must be at 300dpi or better. If not continuous feed, the printer must be capable of printing with 8.5" x 14" paper. Printers must have enough memory to print twelve 176 x 144 resolution (1.5" x 1.25") graphic images (pixels) in 64 shades of gray with the remainder of the 8.5 x 14 page filled with text. Page printers (printers that process total pages in memory before printing them) must be expandable to 4Mb of memory. Vehicle inspection reports (VIR) shall be printed for passing and failing vehicle inspections and as duplicates for a passing/failing inspection. In addition, the printer shall be used to print waivers, challenges, and unofficial tests.

The printers shall be easily accessible to allow the clearing of paper jams, replacement of paper, ink cartridges, toner, etc.

b   Sticker Printer

The RI2000 shall include a dot matrix printer to print windshield stickers for passing, failing and waived vehicles. The printer shall be selectable for 10, 12, or 17.1 character per inch. Print speed in utility printing (normal mode) will be at least 20 characters per second. Dot matrix head pin impact will be capable of generating 4 copies plus original on 20 pound paper.

This printer will be secured by the cabinet from tampering with the printer or the inspection stickers.

The dot matrix printer will be in a secured area of the workstation cabinet. Access to the sticker storage area will be software controlled via solenoid actuated with the shop manager's personal identification code only. This software shall not effect any other secured areas.

Stickers, with preprinted barcodes, will be used as blank stocks for printing passing, failing and waiver stickers. Blank stickers are the same for passing, failed, and waived vehicles.

1.1.62.3.6 *Running Changes and Other Hardware Modifications*

Rhode Island must approve component specifications and any modifications to the hardware prior to field deployment. It will be the instrument manufacturer's responsibility to confirm that such changes have no detrimental effect on RI2000 hardware and software performance. Changes to the hardware shall cause software compatibility verification by the RI2000 manufacturer. Hardware changes shall cause the software to be verified per 3.2.3.

a   Only Rhode Island-approved hardware and options may be used in RI2000 analyzers.

b   All proposed hardware modifications and options must be thoroughly tested before being submitted to Rhode Island.

c   ALL proposed hardware modifications, including manufacturer-initiated

modifications, must be submitted to Rhode Island for testing and approval, prior to field deployment, as follows:

1 Submit a modified RI2000 analyzer to Rhode Island or arrange to update the Engineering test unit (i.e. witness unit).

2 All proposed hardware modifications shall be accompanied by a cover letter containing the following information:

   i A description of <u>all</u> of the proposed modifications to be performed (including manufacturer-initiated modifications), a parts list and the installation instructions for the field service representative. Any modifications to the bench or sample system shall also be accompanied with test data and an engineering evaluation regarding the effects of the proposed modifications on the performance and reliability of the analyzer.

   ii A timeline showing when the modifications are expected to be performed (start to finish), and how many existing units will be updated.

   iii If any special procedures are needed to perform the hardware modifications, describe the procedures for performing the update.

   iv If the proposed hardware modifications require changes or additions to the software, documentation for the software update shall be submitted as indicated above.

3 Depending on the type and number of modifications proposed, Rhode Island may require testing at Rhode Island-approved beta test sites prior to release of the hardware or software changes. Rhode Island will perform a preliminary review of the modifications prior to releasing it for beta-site testing.

2.4 Exhaust Gas Analysis Equipment for the RI2000

This section defines the requirements for the equipment needed to determine the mass of the exhaust gases of interest during the transient loaded-mode tests. It covers the analyzers/sensors and sampling systems, including sampling probes, hoses and filters. At a minimum, the RI2000 raw exhaust analysis equipment shall meet the BAR certification requirements. At a minimum, the RI2000 dilute exhaust analysis equipment shall meet the NYTEST certification requirements.

Gases to be measured are hydrocarbons (HC), parts per million as hexane (ppmh); carbon monoxide (CO), percent; carbon dioxide (CO_2), percent; oxygen (O_2), percent; nitric oxide (NO), ppm. Opacity (measured in %) of diesel exhaust

shall be offered as an option.

~~1.1.1~~2.4.1   *General Design Requirements*

The RI2000 requires the use of the VMAS device utilized in the NYTEST for exhaust volume measurement. The technique coupled with RI2000 concentration analyzers shall provide for a method for exhaust mass measurement.

~~1.1.2~~2.4.2   *General Requirements*

a   System Make-up

The emission analysis system shall automatically sample, integrate, and record the specified emission values for HC, CO, CO_2, NO, and O_2.

b   Alternative Designs

The Program Administrator may approve alternative analytic equipment, specifications, materials, designs, and/or detection methods that meet performance specifications.

c   Tampering

All switches or adjustment devices that can affect or alter emission test results shall be secure from tampering. Access to such switches or adjustment devices shall be restricted to authorized personnel. All access to such switches or adjustment devices shall be logged. However, tamper detection may be provided for all or groups of switches and adjustment devices rather than for each individual switch or adjustment device. For example, multiple adjustment devices may be secured behind locked panels such that removal or opening of a panel will be detected and trigger a lockout (system state that prevents valid testing).

Note: Specifically, a cable-disconnect and an open cover sensor shall be provided with the VMAS device. A lithium rechargeable battery (or non-rechargeable battery with > 6 month life) and memory circuits will sense tampering when the unit is disconnected, even without external power provided.

d   Outside Venting

The manufacturer shall determine whether outside venting is necessary to ~~i~~ensure proper performance of the analyzer.

~~1.1.3~~2.4.3   *Sampling Systems (except Opacity)*

The sampling system shall draw exhaust gas from the vehicle, shall remove particulate matter and aerosols from the sampled gas, shall drain condensed water from the sample if necessary, and shall deliver the resultant gas sample to the analyzers/sensors for analysis. The analyzed sample shall be released outside the building. The sampling system shall, at a minimum, consist of a tailpipe probe, flexible sample line, water

removal system, a particulate trap, sample pump, and flow control components.

a   Sampling Devices

During testing, the sampling device shall be located so as to collect only the appropriate sample.

b   Sample Flow

The sampling device (for raw exhaust) shall be designed to provide a continuous adequate sample volume (flow rate) for analysis, as required by gas analyzers. Sample volumetric flow criteria shall be established and the system shall monitor sample flow during each test to determine if sample flow is in compliance with established criteria. The compliance criteria are satisfied if the response time check is within limits. If response check is not in compliance with established criteria, the RI2000 shall be locked out until the sample flow malfunction is corrected.

c   Dual Exhaust

For dual exhaust systems, the design used shall ensure that each leg of the sample collection system maintains equal flow and collects the required amount of exhaust from the appropriate subject tailpipe. Equal flow shall be assumed if the dual exhaust collector design is that of a "Y" with equal dimension mixing devices, equal length (to within ± 1 foot) legs, and with circular cross sections that are of constant equal diameter. The data analysis software shall account for any differences in transport times between single tailpipe and dual tailpipe collection systems so that time alignment of emission data and speed/time data is accurate in both cases.

The RI2000 must be supplied with exhaust collection cones and hoses to measure exhaust from vehicles with dual exhaust. Software algorithms that extrapolate based on measurement of one leg of a dual exhaust vehicle will not be permitted.

d   Back-Purge

The sample systems provided shall have back-purge capabilities. The back-purge will be used to determine transport time and changes in transport time in the raw sample train. Rhode Island will consider alternate methods using the low flow sensor as long as the method adequately measures and records transport time variation. This procedure must be submitted in writing for review by KTI.

e   Inlet Hose specifications: Material

Silicone impregnated fiberglass with temperature rating of at least 550F. Minimum 4" inner diameter, but 4.25" provides substantially more flow and adapts easier to VMAS™ endcaps. Length must be at least 15 ft, but can increase as long as minimum flow limits or the dilute transport times are

exceeded during a test. A nominal system with hoses in good condition with no sharp bends is 300 ACFM. Total Inlet plus Exhaust hose length should be 30 ft minimum and 45 ft maximum.

f   *Exhaust hose specifications: Material*

Silicone impregnated fiberglass, neoprene-acrylic or other material rated to at least 325F. Minimum 4" inner diameter, but 4.25" provides substantially more flow and adapts easier to Vmas™ endcaps. Minimum length is 30 ft, but can vary as long as minimum flow limits are exceeded during a test. A nominal system with hoses in good condition with no sharp bends is 300 ACFM. Total Inlet plus Exhaust hose length should be 30 ft minimum and 45 ft maximum.

g   *Collection cone*

Silicone fabric rated to at least 550F. Minimum 8" at opening, tapered to hose diameter, with a length of 10" or greater.

1.1.42.4.4 Analyzer Requirements

a   *Automatic Zero*

The analyzer shall conduct an automatic zero adjustment (or equivalent, with Program Administrator approval), prior to each test. The zero adjustment shall include the HC, CO, CO_2 and NO channels. The raw O_2 channel shall have its span adjusted, using generated zero air, while the other channels are being zeroed. The dilute O_2 channel shall have its span adjusted when the VMAS is sampling ambient air. The raw analyzers shall perform two steps while zeroing:

1   Zero Air: The analyzer shall be zeroed, and the O_2 sensor spanned, using generated zero air. The RI2000 manufacturer shall use the same procedure for zeroing that was certified by the California Bureau of Automotive Repair.

2   Ambient Air: Ambient air, filtered for particulates, shall be introduced to the analyzer before the sample pump, but after the sample probe, hose and filter/water trap. The analyzer shall record the concentrations of the five measured gases, but shall make no adjustments.

The analyzer shall be locked out from testing until the ambient air has less than 15 ppm HC, 0.02% CO and 25 ppm NO.

b   *Zero Drift Lockout Threshold*

If zero and/or span drift cause the infrared signal levels to move beyond the adjustment range of the analyzer, the operator shall be locked out from testing and instructed to call for service. (The analyzer manufacturer shall indicate, in writing, at what point the drift lockout will occur.)

c   *Analyzer Calibration and Leak Check*

The analyzer shall, to the maximum extent possible, maintain accuracy between gas calibrations taking into account all errors including noise, repeatability, drift, linearity, temperature and barometric pressure.

1   General: The analyzer shall automatically require, and successfully pass, a floppy drive check, leak check, and a gas calibration for HC, CO, CO_2, raw O_2, dilute O2 and NO by a method that is approved by the Program Administrator at least every XX hours (configured from the HCS), or the analyzer shall lock itself out from further I/M tests. The gas calibration shall ensure that accuracy specifications are satisfied or the analyzer shall be automatically prohibited from performing any portion of the I/M test. The gas calibration procedure shall correct the readings to the center of the allowable tolerance range. When a gas calibration is initiated, the analyzer channels shall actually be adjusted. It is not sufficient to merely check the calibration and do nothing if the analyzer is within allowable tolerances.

2   Gas Calibration Procedure: Gas calibration shall be accomplished by introducing gases traceable to the National Institute of Standards and Technology (NIST) into the analyzer either through the calibration port or through the probe. High range calibration gas shall be introduced first, and the analyzer output shall be adjusted to the center of the tolerance range. Low range calibration gas shall then be introduced and the analyzer output automatically checked to verify that it is within the allowable reading tolerances.

3   Calibration Gases: Calibration span gases and zero air utilized for calibration shall have a ±2% blend tolerance and a ±1% certified accuracy, and shall be provided by a KTI-certified gas blender. No more than 4.5 liters of each gas shall be required to successfully perform a gas calibration; exceptions shall be subject to Program Administrator approval.

The analyzer shall be designed, in a manner approved by the RI, to accommodate the gas cylinders, air generators and other hardware necessary to perform the three-day gas calibration. Other configurations may be submitted for RI's consideration. Note that if air generators are used to provide zero air, the resulting oxygen content shall be ±1% of the nominal value. The analyzer shall be equipped with a gas calibration port. Gas cylinder mounting shall provide adequate room for routine access, servicing and replacement of cylinders, regulators, etc. Brackets and other hardware shall be located so that analyzer stability and impact

protection is considered in the design. The gas cylinder storage area shall be actively ventilated to prevent gas buildup in case of leakage.

The analyzer manufacturer shall design the connectors used with the gas cylinders so that cylinders containing different concentrations or compositions of gas cannot be switched. As an alternative, the manufacturer may use the same connectors on all required cylinders if they display a message instructing the operator to properly connect the hoses to the gas calibration cylinders when they are not connected correctly. In addition for this alternative, some type of reasonably permanent, prominent label or tag shall be used to readily identify which hose should be attached to which cylinder. Other alternatives may be presented to the Program Administrator for consideration. In any event, disposable cylinders shall be equipped with CGA 165 connectors.

Separate regulators shall be used for each cylinder necessary to perform a gas calibration. Regulator materials shall be compatible with the gases of interest.

The following calibration gases shall be used.

i   Zero Air:

         Concentrations: 20.9% O_2, balance N_2.

         Impurities: <1 ppm THC, CO, NO; <200 ppm CO_2.

ii   Low Range:

         200 ppm   propane

         0.50%   carbon monoxide

         6.0%   carbon dioxide

         300 ppm   nitric oxide

         Balance: oxygen-free nitrogen

iii   High Range:

         3200 ppm   propane

         8.00%   carbon monoxide

         12.0%   carbon dioxide

         3000 ppm   nitric oxide

         Balance: oxygen-free nitrogen

4   Zero Air Generators

Zero air will be supplied from a zero air generator. The zero air generator will <u>not</u> be supplied by the RI2000 manufacturerThe RI2000 cabinets shall have four pre-drilled holes for mounting the generator, routing available for the generator power line (120v three prong standard outlet male power plug) and a proper length zero air line with 1/8" male NPT fitting.

The zero air generator shall meet the following minimum requirements.

i   *Output Air Purity:* Generator output air shall meet the purity requirements of c) 3. i., above, when provided with inlet air containing no more than 100 ppm total hydrocarbons as methane, 100 ppm CO, 500 ppm CO_2, and 50 ppm NO_x.

ii   *Output Dewpoint:*   -40F

iii   *Output Particulates:* Filtration shall be 99.99% effective at 0.5 micron.

iv   *Operating Temperature Range:* +35°F to +110°F (2°C to 43°C)

v   *Warmup Time:* The zero air generator shall be capable of providing a stabilized supply of air meeting the output purity and dewpoint requirements listed above in less than 30 minutes.

vi   *Mounting:* The air generator shall be mounted externally to the RI2000 cabinet; however, the configuration (1) shall comply with all applicable electrical and safety codes, (2) shall meet applicable Underwriters' Laboratories requirements (or RI-approved equivalent), and (3) shall not cause the response time requirements of §2.4.5. r) and 2.4.6 g) to be exceeded. In any event, the separation between an externally-mounted zero air generator and the RI2000 cabinet shall not exceed 25 feet.

vii   *Connecting Hose:* As a minimum, the hose connecting an externally-mounted zero air generator and the RI2000 cabinet shall meet the analyzer sample hose requirements specified in §2.4.6. b).

5   Other Requirements

The gas calibration and leak check procedures shall require no more than five minutes. The analyzer shall provide adequate prompts on the display to guide the Inspector

through the calibration procedure in a manner that minimizes the amount of gas used. The analyzer shall be designed to keep the loss of calibration gas to an absolute minimum (less than 0.1 liter in 24 hours) if the operator forgets to shut the valve off.

6   Alternate Calibration Frequencies

Proposals for less frequent gas calibrations will be subjected to lengthy accuracy and drift tests. Proposals of this type shall be thoroughly evaluated (e.g., lab as well as field testing in the range of the required span points for accuracy and drift for extended periods of time) and characterized prior to submission to RI.

d   Propane Equivalency Factor

The nominal PEF range shall be between 0.490 and 0.540. For each audit/calibration point, the nominal PEF shall be conveniently displayed for the quality assurance inspectors and the RI field representatives, in a manner acceptable to RI. The analyzer shall incorporate an algorithm relating PEF to HC concentration. Corrections shall be made automatically. The corrected PEF value may cover the range of 0.470 to 0.560.

e   NDIR Beam Strength

The beam strength from the source to the detector for all channels shall be monitored such that when the beam degrades beyond the adjustment range of the analyzer, the analyzer shall be locked out from operation. The manufacturer shall specify at what point degradation occurs whereby the signal cannot be corrected.

f   Date of Last Gas Calibration

The date of the last gas calibration shall be kept in non-volatile memory (or on the hard disk) and shall be displayed on the status page. When the system check is adjusted, if the date/time change, positive or negative, is greater than 48 hours, three-day gas calibration/leak check shall be required.

g   Lockout Criteria

If the RI2000 has not successfully passed a gas calibration and a leak check within the frequency of time indicated by NETWORK.DAT, it shall lock itself out from performing an official I/M test and shall display a message to the operator upon startup.

h   Audit Gas Pressure

During a gas audit, analyzer readings shall not change by more than 1% of the reading if the audit gas pressure is modified by ±1.5 PSI from the atmospheric absolute pressure at the probe.

i   *Audit Gas Blends:*

There shall be four audit gas blends: Low Range, Mid Range #1, Mid Range #2, and High Range. Their concentrations, with ±2% blend tolerance and ±1% certified accuracy, shall be as follows:

   1   Zero Air

      Same as zero air calibration gas, except that CO_2 impurity level shall be <1 ppm

   2   Low Range

      Same as Low Range calibration gas

   3   Mid Range #1

      960 ppm   propane

      2.40%   carbon monoxide

      3.6%   carbon dioxide

      900 ppm   nitric oxide

      Balance: oxygen-free nitrogen

   4   Mid Range #2

      1920 ppm   propane

      4.80%   carbon monoxide

      7.2%   carbon dioxide

      1800 ppm   nitric oxide

      Balance: oxygen-free nitrogen

   5   High Range

      Same as High Range calibration gas

j   *Range and Accuracy:*

Emissions Analyzer Range and Accuracy						
Gas	Range	Accuracy, % of point	Accuracy, absolute	Range	Accuracy, % of point	Accuracy , absolute
HC	0-2000 ppmh	±3%	4 ppmh	2001- 5000 ppmh 5001 - 9999 ppmh	±5% ±10%	N/A N/A
CO	0 - 10.00%	±3%	0.02% CO	10.01-14.00%	±5%	N/A
CO_2	0 - 16%	±3%	0.3% CO_2	16.1 - 18%	±5%	N/A
NO	0 - 4000 ppm	±4%	25 ppm	4001-5000 ppm	±8%	N/A

| O$_2$ | 0 - 25% | ±5% | 0.1% O$_2$ | - | - | - |

Rounding beyond the decimal places shown in the table shall follow the standard mathematical practice of going to next higher number for any numerical value of five or more. **NOTE: This shall also hold true for pass/fail decisions during an I/M inspection. For example, if 2.00% CO passes but 2.01% CO fails and the reading is 2.0049%, the value shall be rounded down and the decision shall be "Pass;" however, if the reading is 2.0050, the value shall be rounded up and the decision shall be "Fail." Thus, the value displayed and printed on the VIR shall be consistent with the value used for the pass/fail decision.**

k   *Repeatability:*

<table>
<tr><th colspan="7">Emissions Analyzer Repeatability</th></tr>
<tr><th>Gas</th><th>Range</th><th>Repeatability, % of point</th><th>Repeatability, absolute</th><th>Range</th><th>Repeatability, % of point</th><th>Repeatability, absolute</th></tr>
<tr><td>HC</td><td>0-1400 ppmh</td><td>±2%</td><td>3 ppmh</td><td>1400-2000 ppmh</td><td>±3%</td><td>N/A</td></tr>
<tr><td>CO</td><td>0 - 7.00%</td><td>±2%</td><td>0.02% CO</td><td>7.01-10.00%</td><td>±3%</td><td>N/A</td></tr>
<tr><td>CO$_2$</td><td>0 – 10%</td><td>±2%</td><td>0.1% CO$_2$</td><td>10 - 16%</td><td>±3%</td><td>N/A</td></tr>
<tr><td>NO</td><td>0 – 4000 ppm</td><td>±3%</td><td>20 ppm</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>O$_2$</td><td>0 – 25%</td><td>±3%</td><td>0.1% O$_2$</td><td>-</td><td>-</td><td>-</td></tr>
</table>

Accuracy and repeatability shall be defined by the test procedures in Section 5.

l   Noise*:*

<table>
<tr><th colspan="7">Emissions Analyzer Noise</th></tr>
<tr><th>Gas</th><th>Range</th><th>Noise, % of point</th><th>Noise, absolute</th><th>Range</th><th>Noise, % of point</th><th>Noise, absolute</th></tr>
<tr><td>HC</td><td>0-1400 ppmh</td><td>±0.8%</td><td>2 ppmh</td><td>1400-2000 ppmh</td><td>±1%</td><td>N/A</td></tr>
<tr><td>CO</td><td>0 - 7.00%</td><td>±0.8%</td><td>0.01% CO</td><td>7.01-10.00%</td><td>±1%</td><td>N/A</td></tr>
<tr><td>CO$_2$</td><td>0 – 10%</td><td>±0.8%</td><td>0.1% CO$_2$</td><td>10 - 16%</td><td>±1%</td><td>N/A</td></tr>
</table>

NO	0 – 4000 ppm	±1%	10 ppm	-	-	-
O_2	0 – 25%	±1.5%	0.1% O_2	-	-	-

Noise shall be defined operationally as follows: Sample Mid Range #1 Audit Gas for 20 seconds. Collect all the analyzer output readings for each channel over the 20 seconds. (For example, if the analyzer outputs are read by the RI2000 at the rate of twice per second, the total number of readings would be 40.) The peak-to-peak noise shall be calculated as:

$$NOISE \cdot \frac{\sqrt{j \quad (X_i \& \bar{x})^2}}{n}$$

where x_i = the ith reading of the set of readings
$\bar{\ }$ = the arithmetic average of the set of readings
n = the total number of readings

The noise, as calculated above, shall be within the limits specified in the table above, AND, in the set of data collected, no more than 5% of the readings in the set shall deviate (peak-to-peak) from the average by more than 150% of the specified limits.

m   *Minimum Analyzer Display Resolution*

The analyzer electronics shall have sufficient resolution and accuracy to achieve the following:

HC	1 ppm	HC
CO	0.01%	CO
CO_2	0.1%	CO_2
NO	1 ppm	NO
O2	0.1%	O2
RPM	1	RPM
Speed	0.1	mph
Load	0.1	hp

n   *Display Refresh Rate*

Dynamic information being displayed shall be refreshed at a minimum of twice per second. Alternatives may be submitted to the Program Administrator for its approval.

o   *Interference Effects:*

Gas analyzer interference effects shall not cause an absolute uncertainty in grams per mile in excess of 50% of the allowable performance uncertainty as specified. Interference effects shall include interference from any non-interest gases, other exhaust components (including water vapor), and aerosols, artifacts, or other spurious effects.

In addition, the interference effects from non-interest gases shall not exceed ±4 ppm for HC, ±0.02% for CO, ±0.20% for CO2, ±20 ppm for NO. Corrections for collision-broadening effects of combined high CO and CO2 concentrations shall be taken into account in developing the factory calibration curves, and is included in the accuracy specifications. Interference gases shall be as follows:

<u>Interference Gases</u>

16%	Carbon Dioxide in Nitrogen
1600 ppm	Hexane in Nitrogen
10%	Carbon Monoxide in Nitrogen
3000 ppm	Nitric Oxide in Nitrogen
75 ppm	Hydrogen Sulfide in Nitrogen
75 ppm	Sulfur Dioxide in Nitrogen
18%	Carbon Dioxide <u>and</u> 9% Carbon Monoxide in Nitrogen

Water-Saturated Hot Air

NOTE: Interference gases shall have a ±2% blend tolerance and ±2% certified accuracy.

p   *Warm-up Time*

The analyzer shall reach stability within 30 minutes at 35°F from startup. If an analyzer does not achieve stability within the allotted time frame, it shall be locked out from I/M testing and a message shall be displayed instructing the operator to call for service.

q   *System Lockout During Warm-up*

Functional operation of the gas-sampling unit shall remain disabled through a system lockout until the instrument meets stability and warm-up requirements. The instrument shall be considered "warmed-up" when internal analyzer verifications are complete and the zero readings for HC, CO, CO2, raw O2, dilute O2 and NO have stabilized, within the allowable accuracy values, for five minutes without adjustment.

r   *Analyzer/Sensor Response Times*

Analyzer/sensor response times are defined as follows:

1   Rise time: When a gas is introduced to a sensor's sample cell

inlet or inlet port (t_0), the time required by the sensor's output to rise from first indication of response to the input gas to a given percentage of the final stable reading of a gas's concentration. Two rise times are specified:

i T_{90}: The time required to reach 90% of the final gas concentration reading from first indication of response to the input gas.

ii T_{95}: The time required to reach 95% of the final gas concentration reading from first indication of response to the input gas.

2   Fall Time: When a gas is removed from a sensor's sample cell inlet or inlet port (t_S), the time required by the sensor's output to fall from first indication of withdrawal of the gas to a given percentage of the final stable reading of a gas's concentration. Two fall times are specified:

i T_{10}: The time required to fall to 10% of the stable gas concentration reading from first indication of withdrawal of the gas.

ii T_5: The time required to fall to 5% of the stable gas concentration reading from first indication of withdrawal of the gas.

Requirements

	Maximum Response Time in Seconds For Each Channel	
	HC, CO, CO_2	NO
T_{90}	3.5	4.5
T_{95}	4.5	5.5
T_{10}	3.7	4.7
T_5	4.7	5.7

The differences between T_{90} and T_{10}, and between T_{95} and T_5, shall be no greater than 0.3 seconds.

Maximum response time for O2 at T90 and T10 is 8 seconds.

s   HC Hangup

The HC hangup shall be 7 ppm or less before the RI2000 permits an I/M test to begin.

When the analyzer performs a HC hangup check before the start of an inspection, the recorded ambient air readings shall be subtracted from the sampling readings to determine the amount of HC hangup (residual HC) in the sampling system.

The analyzer shall be locked out from testing the residual HC obtained through the sample probe is less than 7 ppm. HC Hang UP = Probe HC Ambient HC.

t   Emissions Accounting/Accuracy

The manufacturer shall ensure that its analytical system provides an accurate accounting of the actual exhaust emissions produced during the test, taking into consideration the individual channel accuracies, repeatabilities, interference effects, sample transport times and analyzer response times.

2.4.5 Sampling System Components

a   General

The system shall be designed to ensure durable, leak free operation and be easily maintained.

The sampling system shall be designed to withstand typical vehicle exhaust temperatures when the vehicle is driven through transient cycles for 1200 consecutive seconds.

Materials that are in contact with the gases sampled shall not contaminate or change the character of the gases to be analyzed. The sampling system shall be designed to be corrosion-resistant for at least five years.

The system shall be designed to ensure durable, leak-free operation and easy maintenance.

b   Raw Sample Hose

The sample hose shall be 25 ft ±0.5 ft in length, when measured from the front of the RI2000 cabinet. Other configurations may be submitted to the Program Administrator for its consideration

The hose material in contact with the exhaust sample shall be nonporous, and shall not absorb, adsorb, react with, or affect the sample in any manner. The outer coating of the hose shall be abrasion-resistant and unaffected by the substances found in a typical service facility's environment.

The sample hose shall be flexible, yet shall resist kinking and crushing.

The sample hose shall be connected to the probe and to the analyzer sample system with screw-type fittings.

The sample hose and probe shall withstand exhaust gas temperatures at the probe tip of up to 1100oF for five (5) minutes.

c   *Sample Probe*

The analyzer manufacturer shall equip the analyzer with a sampling probe which meets the following criteria:

1   Retention - The probe shall incorporate a positive means of retention to prevent it from slipping out of the tailpipe when in use.

2   Hand Grip - A thermally-insulated, securely-attached hand grip shall be provided on the probe in such a manner that easy probe insertion using one hand is insured.

3   Flexibility - The manufacturer shall supply two types of removable probe tips with each analyzer sold. The probe and both probe tips shall meet the following criteria:

   i   the probe shall be designed so that the tip extends 16 inches into the tailpipe;

   ii   the probe and probe tip should be designed so the average garage operator can easily remove and reinstall them without special tools;

   iii   a handle, made of thermally insulating materials, shall be attached to a rigid, reasonably non-crushable portion of tubing made of stainless steel or something equivalent, which can be easily removed from the sample line and reinstalled by the operator; and

   iv   the probe tip shall be shielded so that debris is not scooped up by the probe when it is inserted into the tailpipe.

   v   In addition, one of the probe tips supplied with the analyzer shall be of the traditional style meeting the following specifications:

      a)   flexible enough to extend into a 1½-inch diameter exhaust pipe having a three-inch radius, 45-degree bend; and

      b)   the flexible portion shall be constructed so that it is sealed to prevent any sample dilution.

   vi   The manufacturer shall also supply the analyzer with an essentially straight probe tip (no more than a 15° bend) meeting the following specifications:

a) made of either stainless steel, 3/16 inch outside diameter (OD) solid-wall tubing, which is readily available; and

b) designed so that the connector between the removable probe tip and the rigid portion of tubing is up inside the tailpipe at least three inches to reduce the effects of any leak that might occur.

4   Serviceability - For the purposes of economical replacement, the flexible portion of the probe assembly shall be designed so it can be replaced. The probes supplied shall be readily available.

5   Materials - All materials in contact with exhaust gas prior to and throughout the measurement portion of the system shall be unaffected by and shall not affect the sample (i.e., the materials shall not react with the sample, and they shall not taint the sample). Acceptable materials include, but are not limited to: stainless steel, Teflon®, silicon rubber, and Tedlar®. Dissimilar metals with thermal expansion factors of more than 5% shall not be used in the construction of either probes or connectors. The sample probe shall be constructed of stainless steel or other non-corrosive, non-reactive material that can withstand exhaust gas temperatures at the probe tip of up to $1100^{o}F$.

6   Audit Gas Introduction - Probes shall be designed to allow, or shall be supplied with an adapter allowing, the introduction of audit gas from a one-half inch inside diameter flexible hose. The probe tip or the adapter shall be sized to provide a tight fit so that dilution cannot occur at the probe/hose connection.

7   Probe Cap - A probe tip cap suitable for performing a system leak check shall be provided if the vacuum decay method of leak check is utilized. The cap shall be permanently attached/tethered to the RI2000. Otherwise, whatever hoses and connectors are necessary shall be provided to allow the operator to perform the leak check.

8   Sample Probe Insertion. The sample probe shall allow at least a 16-inch insertion depth of the sample point into the vehicle exhaust. In addition, the probe shall be inserted at least 10 inches into the vehicle exhaust. The use of a tailpipe extension must not change the exhaust back pressure by ± one inch of water pressure.

9   Sample Probe Tip. Probe tips shall be designed and constructed to prevent sample dilution. The probe tip shall be shielded so that the probe does not scoop debris up when it

is inserted into the tailpipe.

d   Particulate Filter and Water Trap

1   The particulate filter shall be capable of trapping 97% of all particulates and aerosols 5 microns or larger.

2   The filter element shall not absorb or adsorb hydrocarbons.

3   The water trap shall be sized to remove exhaust sample water from vehicles fueled with gasoline, gasohol, propane, compressed natural gas (CNG), as well as with alternative and oxygenated fuels, such as methanol (M85), ethanol (E85), and reformulated gasolines with MTBE as the oxygenate. The filter element, bowl and housing shall be inert to these fuels as well as to the exhaust gases from vehicles burning these fuels. The condensed water shall be continuously drained from the water trap's bowl. Sufficient water shall be trapped, regardless of fuel, to prevent condensation in the sample system or in the optical bench's sample cell.

4   The RI2000 filtration system shall be capable of removing sufficient water such that the life of the analytical instrumentation is not effected.

5   The RI2000 filtration system shall be capable of removing sufficient water such that the effect of the water interference during a transient test is less than 10% as compared to the same system equipped with a chiller. This must be true not only for certification but also for the duration of the program.

e   System Leak Check

The analyzer shall require that a leak check be successfully passed on the same frequency as the gas calibration.

The analyzer shall detect a leak that causes an error of more than 1% of reading using High Range RI2000 span gas.

f   System Response Time Requirements For Analyzer Channels:

The overall system response time of the analytical train comprises the Transport Time and the Analyzer/Sensor Response Time (see §2.4.5 r).

1   Transport Time: The time from the exhaust sample's entry into the tip of the sample probe until the analyzer/sensor first begins to respond to the sample. *The Transport Time shall be no more than 5 seconds for HC, CO and CO_2 and no more than 7.5 seconds for NO and O_2.*

2   System Response Time:

     i *HC, CO, & CO$_2$ Channels:* The response rise time (see §2.4.5.r)1) from the probe to the display shall be no more than eight (8) seconds to T$_{90}$. In addition, the response fall time shall be no greater than 8.3 seconds to T$_{10}$.

     ii *NO Channel:* The response rise time (see §2.4.5 r) i) from the probe to the display shall be no more than 12 seconds to T$_{90}$. In addition, the response fall time shall be no greater than 12.4 seconds to T$_{10}$.

     iii *O$_2$ Channel:* The response rise time shall be no greater than 15 seconds to T$_{90}$. The response fall time for a step change in concentration from 20.9% O$_2$ to 0.1% O$_2$ shall be not greater than 40 seconds.

   3 Dilute System Response Time

    The system response time to reach t90 for the dilute analyzer shall not exceed 2 seconds. The system begins at the inlet of the exhaust sampling cones.

 g *Hangup Check*

Activation of the emission measurement mode of the RI2000 shall be prevented unless a successful hangup check has been performed immediately prior to the test sequence. Hangup shall not exceed 7 ppm hexane prior to testing. A unit with a clean sample system shall have an HC hangup time of no more than 120 seconds. If the HC hangup does not drop below 7 ppm within 150 seconds, the following message shall be displayed: **"POSSIBLE DIRTY FILTERS OR SAMPLE LINE."**

 h *Dilution*

The analyzer supplier shall demonstrate to the satisfaction of the Program Administrator that the flow rate on the RI2000 unit shall not cause more than 2% dilution during sampling of the exhaust of a 1.6L engine at normal idle. Two percent dilution is defined as a sample of 98% exhaust and 2% ambient air.

 i *Analyzer Flow Stability Criteria*

A fixed, optimized, "operational" sample flow to each analyzer shall be determined and established as a criterion for sample flow. The sample flow to each analyzer shall be monitored during calibration, zero/span operations, emissions testing, and all other analyzer system operations. If, at any time, the measured sample flow for an analyzer would cause the system response time to exceed 15 seconds for 90% response to a step change input, a system lockout shall occur.

2.4.6 Temperature Operating Range

The analyzer, including all of the software/hardware enclosed in the cabinet, shall operate within the performance specifications described herein in ambient air temperatures ranging from 35o to 110oF. Analyzers shall be designed so that adequate airflow is provided around critical components to prevent overheating (and automatic shutdown) and to prevent the condensation of water vapor, which could reduce the reliability and durability of the analyzer. Analyzers shall be designed so that adequate airflow is provided to prevent any overheating. The analyzer system shall, where necessary, include features to maintain the analyzer sampling and analysis systems within the required temperature range for proper operation under all emission test environmental conditions.

2.4.7 Humidity Operating Range

The analyzer, including all of the software/hardware enclosed in the cabinet, shall operate within the performance specifications described herein at up to 85% relative humidity throughout the required temperature range. The RI2000 shall operate without being locked out if the Relative Humidity exceeds 85%.

2.4.8 Opacity

An opacity option shall be offered for use in testing light- and medium-duty diesel-powered vehicles. It shall be a partial-flow device, and shall interface seamlessly with the analyzer software via an RS232C port. A DB25 pin serial port or other RI-approved connector is required. Adjustments such as electronic signal filtering shall be incorporated so as to correlate with other opacity-measuring devices and standards. The devices shall be calibrated at a frequency set by the HCS.

The Opacity Meter shall meet or exceed the requirements in the SAE 1667 procedure.

2.4.9 Humidity

Relative humidity shall be measured prior to the start of every inspection in order to calculate Kh, the nitric oxide humidity correction factor. The humidity-measuring device shall have the following minimum characteristics:

Range:	5% - 95% Relative Humidity
Sensor Accuracy:	±3% of full scale or better
Operating Temperature Range:	35^oF - 110^oF

The relative humidity reading shall be recorded in the Relative Humidity field of the test record.

2.4.10 Ambient Temperature Measurement

Ambient temperature shall be measured prior to the start of every inspection, and shall be recorded in the Ambient Temperature field of the test record. The temperature-measuring device shall have the following

minimum characteristics:

Range: 0 - 140oF

Accuracy: ±3oF

2.4.11 Barometric Pressure Measurement

Barometric pressure shall be measured prior to the start of every inspection, and shall be recorded in the Barometric Pressure field of the test record.   The barometric measuring device shall have the following minimum characteristics:

Range: 24 - 32 in. Hg absolute

Accuracy: ± 3% of point or better

Operating Temperature Range: 35oF - 110oF

2.4.12 Blower specifications:

Performance at .075 lb/ft3 standard density: 250 CFM @ 5-6" SPWG (static pressure in inches of water, gage pressure), 3450 RPM and 0.6 BHP (brake horsepower). Blower shall have ¾ HP motor, cast aluminum housing, high temperature bearings, and shaft seal.

2.4.13 VMAS

The RI2000 system with a 5-gas analyzer, a chassis dynamometer, and a VMAS™ dilute sample system, which adds the ability to measure mass of pollutants on a second-by-second basis. Each second during an emissions test, the VMAS™ microprocessor collects raw, or undiluted gas concentrations from the RI2000 system, and then computes mass results by combining these measurements with exhaust volume calculations based on dilute flow measurements. The dilute flow is comprised of the total exhaust flow plus ambient air pulled through a collection cone and sample hose by a blower. The blower then feeds into the VMAS™ analyzer and exhaust hose. Each of the components is described in detail in this specification.
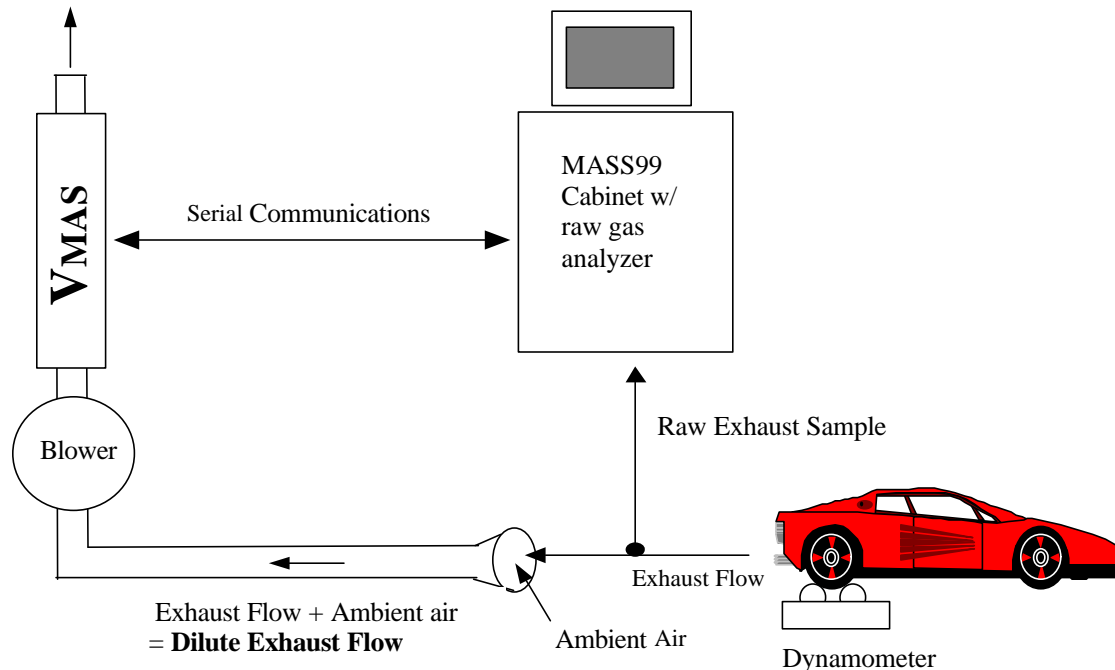
VMAS Components and Terminology

The RI2000 vehicle inspection systems include a VMAS™ analyzer, which provides the ability for the system to measure pollutant mass on a second-by-second basis. The VMAS™ analyzer measures both diluted exhaust flow and dilution ratio, and uses these measurements to calculate the exhaust volume on a second-by-second basis. It then uses the calculated exhaust volume in conjunction with the measured exhaust gas pollutant concentrations from the RI2000 analyzer to calculate the mass of pollutants produced by a vehicle each second during an emissions test. (This in turn can be used either with time or distance information to generate emission rates, e.g., g/sec or g/mi). Both the measurement of the diluted exhaust flow and the dilution ratio will be explained, and the overall calculation of the exhaust mass will then be given. Limits on the allowed measurement errors and methods to ensure accurate parameter measurement will also be provided.

VMAS^ô Analyzer

a   *VMAS^Ô Components*

Piezo-electric cells

Vortex Strut

Dilute exhaust flow

Thermistor

VMAS microprocessor

Power supply

Zirconia O2 flow chamber and sensor

Pressure transducer
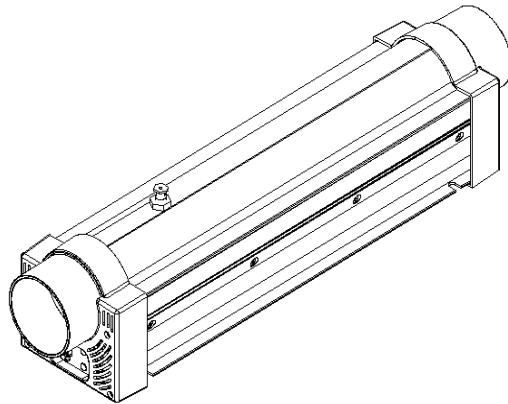
Dual RS232 serial communications
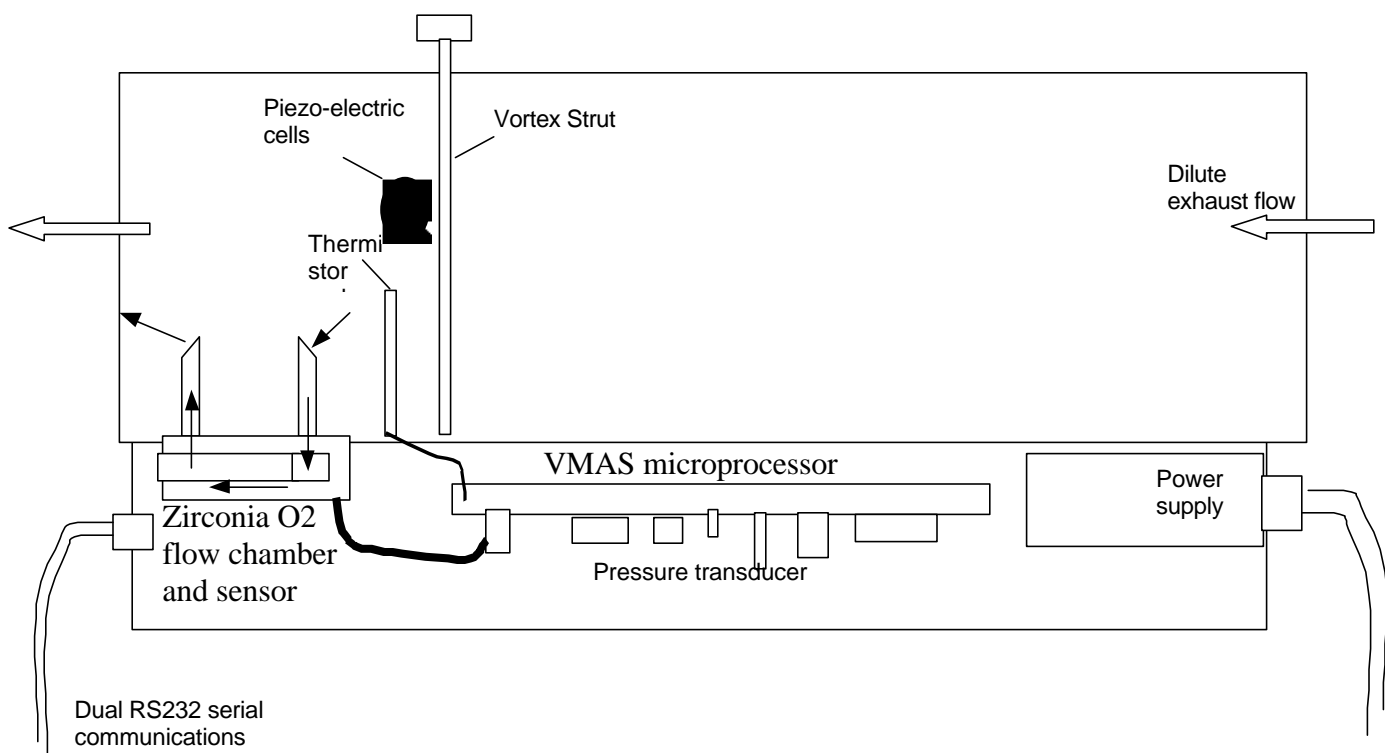
1. VMAS™ Microprocessor – controls the data collection from the gas analyzer in the RI2000 system, the VMAS™ vortex flowmeter and the VMAS™ dilute O_2 sensor each second during a test. It furthermore performs the calculations discussed above each second, and stores the results in a buffer that is transmitted to the

RI2000 at the end of the test. It also contains all calibration information for the VMAS™ components.

2. <u>Zirconia O$_2$ Sensor</u> – a fast response sensor used to measure the varying oxygen in the dilute flowrate each second during the test. It also measures the ambient O$_2$ before the test. These are used in the calculation of dilution ratio as described below. The zirconia O$_2$ sensor requires no sample system or filtering. Flow is forced into the inlet pitot tube as shown in the diagram, where it contacts the zirconia sensor and exits. The temperature of the zirconia is maintained at approximately 700 degrees C for optimal performance and to burn off any particulates or water condensation.

3. <u>Vortex flowmeter</u> – measures the dilute flowrate which is then used to determine the exhaust flowrate and mass emissions calculations as described below. The <u>Strut</u> is a critical component of the vortex flowmeter. It is used to create vortices in the dilute flow as it passes its cylindrical cross section. These vortices are shed at a rate proportional to the dilute flowrate. The strut geometry is important for the flow calibration, so it is important that it does not get damaged or too dirty. It is easily removable for cleaning.

<u>Piezo-electric sensors</u> are the other components of the vortex flowmeter. They are used to measure the rate at which the vortices are shed from the strut. As air flows past the strut, vortices are generated. The transmitting piezo sends a continuous, high frequency ultrasonic signal to the receiving piezo. The vortices shed off the strut reduce the amplitude of the received signal. The frequency of the changes in amplitude (the vortex shedding rate) is then proportional to the flow rate.

Receive Piezo

Vortices shed from the strut interfere with ultrasonic waves sent by the Transmit piezo to the Receive piezo.

Dilute Flow

Strut

Transmit Piezo
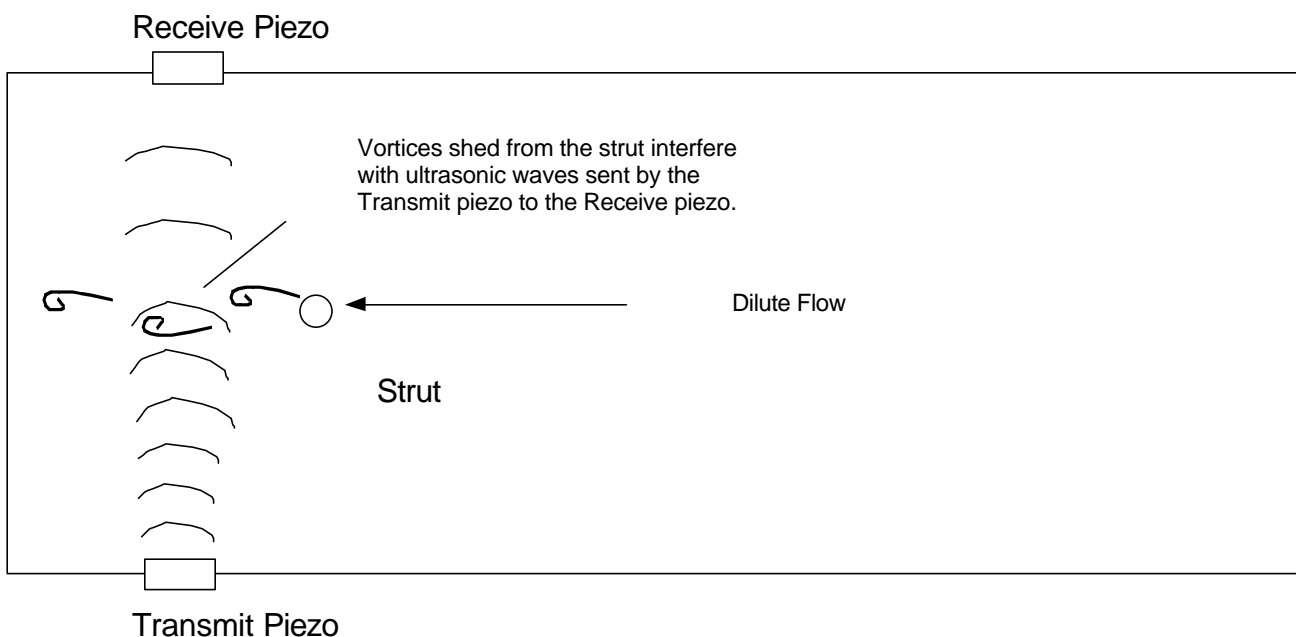
<u>VMAS゜ Vortex Flowmeter (top view)</u>

b   Dilute flow Calibration

The flow rate of the diluted exhaust is measured by the VMAS™ vortex flowmeter, as described above. The relationship between the vortex shedding rate and the flow rate is linear over the range of the flow measured by the system (typically 250 - 350 SCFM, with 200 SCFM minimum). Two-point calibrations are performed within these limits with a reference flow device of at least 1% accuracy, as illustrated below. A smooth approach orifice (SAO) or laminar flow element (LFE) are suitable for this purpose and for auditing. The calibration parameters are stored in the VMAS™ microprocessor.
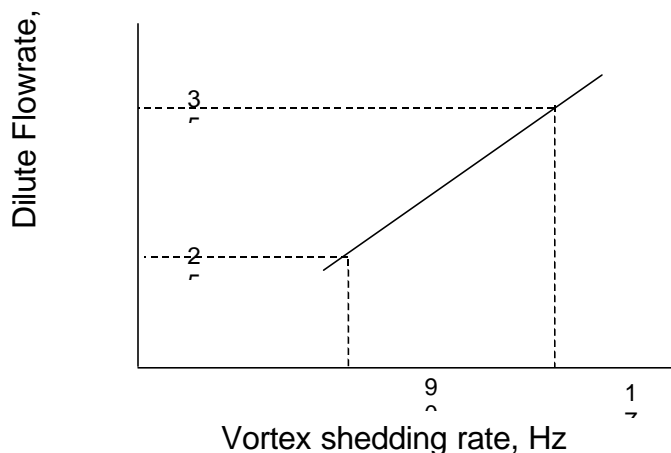
Typical 2-point VMAS™ Flowmeter Calibration

c   Standard Pressure and Temperature Corrections

Flow is required to be reported at standard temperature and pressure (ACFM, or actual standard cubic feet per minute measurements are adjusted to standard cubic feet per minute, SCFM). To compute SCFM, the dilute temperature and pressure are used according to the formula below. The temperature and pressure are measured by VMAS™ in the flow stream near the point of flow measurement. Both measurements shall be able to be audited through the analyzer audit menu and shall have an accuracy of ±3% on an absolute basis (degrees K or R, and milibars).

To convert from ACFM to SCFM:

SCFM = ACFM x (528/T gas in degrees R) x (P gas in milibars/1000)

This calculation is performed automatically in the VMAS™ microprocessor during every data collection.

d   Dilute Flow Errors and Corrective Actions

Errors in the flow measurement system can come from accumulation of dirt on the strut or the piezo transducers. As these become dirty, noise begins to develop in the flow signal as normal and consistent vortices become non-normally spaced in time. The system will detect this by placing limits on flow and flow variability, and will then inform the operator that the system is in need of cleaning. The minimum flow during a test will be 200 SCFM. If the system measures lower than 200 SCFM for 3 consecutive seconds, the test shall be aborted. Variability in flow is measured by the standard deviation of all flow readings during the test. If at the end of the test, the standard deviation of the flow exceeds 15 SCFM, the system should indicate there is a flow measurement problem. This should invalidate the test, and require that the strut and piezos be cleaned. If flow errors persist, service should be called. Cleaning the strut is accomplished by unscrewing it from the top of the device and gently swabbing it off with a de-greasing agent. Cleaning of the piezos is accomplished by removing the exhaust hose, reaching inside the tube, and wiping the piezo surfaces with a small swab or soft tipped brush coated with a de-greasing agent.

e   Hose Off Flow Check

In addition to the variability in flow check indicated above, a "hose off" flow check should be performed on a frequency controlled by the HCS (default frequency at start-up is weekly; provisions should also be made to allow for requiring the calibration based on the number of tests conducted). If the flow rate between the initial calibrated hose off flow rate and the in-use measured hose off flow rate vary by more than a set amount (default is ±10% and is configurable through the HCS), then the system should be locked out ("hose off flow lockout") and cleaning suggested. After cleaning, the system should be retested. If the system still fails the hose off flow check, then it should be locked out and factory service required.

At the time of installation, all systems will have their flow measured with the intake and exhaust hoses removed. The sample time of the "hose-off" test should be at least 30 seconds. The average flow should be recorded in the system computer. This average "hose off" flowrate is used as a reference to ensure no changes are taking place in the flow measurement as the equipment ages.

f   Dilution ratio

The dilution ratio is calculated by the VMAS™ microprocessor by comparing the oxygen content in the raw exhaust compared to the oxygen content in the dilute exhaust. The sensor used to measure the dilute exhaust is a fast response (T_{90} fall or rise of less than one second full scale), zirconia type with a sampling rate of at least 0.5 seconds. The sensor has a linear response and is calibrated at a single point using ambient air. The VMAS™ microprocessor also has internal logic that reports when the sensor is not functioning properly.

The dilution ratio is calculated as follows:

$$\text{Dilution Ratio} = \frac{(\text{ambient } O_2 - \text{dilute } O_2)}{(\text{ambient } O_2 - \text{raw } O_2)}$$

The ambient oxygen measurement is also performed with the zirconia sensor in the dilute flowpath prior to each test. This is done so that any small drift in the sensor is canceled in the numerator of the dilution ratio equation. In other words, the system is really measuring the difference in oxygen before and during the test. If the ambient oxygen reading is outside the limits of 20.8 +/- 0.5%, then the system shall perform an automatic calibration of the sensor.

Oxygen measurements are also used to determine when the dilute collection system is approaching overflow (not being able to collect all of the vehicle's exhaust). When the raw and dilute oxygen measurements are both less than 5%, (dilution ratio exceeds 0.75), a status bit is set in the VMAS™ microprocessor and the RI2000 computer will display a message to abort the test. A reason of "dilution system overflow" shall be recorded in the test record. The same is true if the denominator of the dilution ratio is less than 2 (raw oxygen sensor is not functioning, or the probe is not in the tailpipe). Also, if the numerator is negative (ambient collection was performed improperly), then a status bit in the VMAS™ processor is set, and the RI2000 computer should abort the test.

Calibration of the zirconia oxygen sensor can be performed automatically by sending a command to the VMAS™ microprocessor. The only requirement is that the blower has been on for at least on minute and is sampling clean, ambient air. Calibrations are performed whenever the ambient collection is out of range, as described above.

g   Exhaust flow rate

The flow rate of the vehicle exhaust is computed in the VMAS™ microprocessor using the dilute exhaust flow rate and the dilution ratio according to the following equation:

Exhaust flow rate = dilute exhaust flow rate x dilution ratio

h   Mass calculations

During a data collection, the VMAS™ microprocessor computes mass emissions each second using the following formula:

Mass emissions (grams/second) = Concentration x   Density x Exhaust Flow

where concentrations ($\%CO_2$, $\%CO$, $\%O_2$, ppm HC, ppm NO) are measured from the raw exhaust sample by the RI2000 gas analyzer, and the density of each

pollutant at standard conditions are constant values published in CFR-40.

i   Operation after end of cycle and time alignment

Sampling of emissions readings and exhaust flow shall continue following the end of the driving cycle for a period of time equal to the sum of the sample transport delay time and the larger of the step input response rise or decay time in order to affect time alignment. Emission and exhaust flow data must be time aligned with respect to the driving cycle speed and time. In addition, raw and dilute concentration data must be aligned to properly produce mass measurement. The raw gas from the tailpipe probe sample typically takes 5 – 6 seconds to reach the gas bench, while the exhaust flowrate values are measured almost real-time. The exhaust flow values must be stored in a buffer (delayed) until the concentration values are available. These delay times are measured on the RI2000 system and stored in the VMAS™ microprocessor as a calibration value.

j   Sample rate and adjustment for background concentrations

All dynamic parameters required to calculate emissions or specified by QA/QC protocols shall be monitored at a sample rate of not less than 1 Hz.   The ambient temperature, absolute humidity, and barometric pressure shall be measured within two minutes prior to the start of each emissions test.

k   VMAS^Ô Status Information

During a data collection, VMAS™ sends the following information to the RI2000 computer in the form of a mini-status with 16 status bits. An error bit is set for the following reasons:

- If for some reason VMAS™ is still in warm-up. Indicates a failure of the dilute oxygen sensor, or some other problem.

- If the gas bench stops communicating. The host should abort if set during a test.

- If there is an internal VMAS™ error, such as a faulty O_2 sensor.

- If the dilution ratio is negative. This can occur when there is very little or no exhaust, or if the dilute O_2 reading drifts because the blower was not on for 1 minute before the test. This could also be an indication of other problems. For example, the collection cone could have fallen off the tailpipe, or the car may have been shut off before the collection is finished.

- If the raw O_2 concentration is over 18% (the denominator of the dilution ratio is less than 2). This could indicate that the raw sample probe is not in the tailpipe, or that the sample pump is malfunctioning, or that the bench O_2 is malfunctioning.

- If the blower flowrate drops below a programmable thresh-hold (200 scfm).

- If the gas bench indicates a failure.

- If the dilute gas temperature exceeds the programmable maximum thresh-hold.

- If the gas bench has a low flow error. If filters are plugged, the bench O_2 may not read properly and dilution errors may also result.

- If both dilute O_2 and raw O_2 are less than 5%. In this case, the dilution ratio is exceeding 75%, indicating that there is too much exhaust for the VMAS™ blower.

- If VMAS™ processor board temperature exceeds 70 C.

2.5 Dynamometer & Auxiliary Equipment Specifications

Eddy current dynamometers with fixed base inertia are intended for use in the RI2000 system, so long as the dynamometers meet the specifications described in this document. At a minimum, the RI2000 dynamometers shall meet the NYTEST certification requirements.

~~1.1.1~~2.5.1 Dynamometer Identification

All dynamometers shall have an identification plate permanently affixed showing as a minimum Dynamometer Manufacturer's Name, the System Provider's Name, Production Date, Model Number, Serial Number, Maximum Axle Weight, Maximum HP Absorbed, Roll Diameter, Roll Width, Base Inertia Weight, Electrical Requirements (including Voltage and Amperage).

~~1.1.2~~2.5.2 Two-Wheel Drive Vehicle Dynamometer

The dynamometer shall accommodate all two-wheel drive light-duty vehicles up to 8,500 lbs. GVWR, (except for those vehicles equipped with antilock braking systems (ABS) or traction control (TC) which require a TSI test.)

~~1.1.3~~2.5.3 Power Absorption

a   *Power Absorber Range*

The range of the power absorber at 60 mph shall be sufficient to test all light duty vehicles up to 8,500 pounds GVWR.

b   *Power Absorber Accuracy*

The power absorber shall be adjustable in 0.1 hp increments and the accuracy of the system (PAU + Parasitic Losses) shall be ±0.25 horsepower or ±2.0% of required loading, whichever is greater, in either direction of rotation. (For field auditing the accuracy shall be ±0.5 horsepower.)

c   *Vehicle Loading*

The vehicle loading used during the driving cycles shall follow the equation:

THP = IHP + PLHP + GTRL

where:

THP   =   Total horsepower (tire losses and parasitics) for a test.

IHP   =   Indicated Horsepower value set on the dynamometer.

PLHP =   Parasitic Loss Horsepower due to internal dyno friction.

GTRL =   Generic Tire/Roll interface horsepower losses at speed

Unless otherwise noted, any horsepower displayed during testing shall be THP.

~~1.1.4~~2.5.4 *Inertia*

a   *Base Inertia*

The dynamometer shall be equipped with a mechanical flywheel(s), or with full inertia simulation providing a total base inertia weight of 2000 lbs ±40 lbs. Any deviation from the 2000 pounds base inertia shall be quantified and the coast-down time shall be corrected accordingly. The actual inertia weight ±10 lbs shall be marked on the dynamometer ID plate or on the flywheel.

b   *Inertia/Inertia Simulation*

The dynamometer, as delivered, shall be capable of conducting, as a minimum, transient inertia simulations with an acceleration rate between 0 to 3.3 mph/sec over the inertia weight range of 2,000 to 6,000 lbs.

For the inertia simulation, the hp criterion is a requirement on acceleration only. Mechanical inertia simulation shall be provided in 250 lb. minimum increments; electric inertia simulation shall be provided in one (1) lb. increments. Any deviation from the stated inertia shall be quantified and the inertia simulation shall be corrected accordingly. Mechanical or electrical inertia simulation, or a combination of both, may be used.

1.   System Response - The torque response to a step change shall be at least 90% of the requested change within 200 milliseconds after a step change is commanded by the dynamometer control system, and shall be within 2% of the commanded torque by 300 milliseconds after the command is issued. Overshoot shall not exceed 25% of the torque value.

2.   Instantaneous Horsepower Simulation % Error (IHPSE) - Throughout the drive cycle, the IHPSE shall be computed every .5 seconds and averaged into a five second moving average. If the speed is less than 5 mph, the IHPSE shall be assumed to be 0. A violation occurs if the moving average is > 5%.

$$Inst.\ HP\ \%\ Err.=\left(\frac{(Achieved\ PAU\ Power)-(Desired\ PAU\ Power)}{\dfrac{Accel.Rate(\dfrac{mph}{\sec})*Veh.Weight(lbs.)*Speed(mph)}{8233.0}+RLHP\ @\ Speed}\right)*100$$

3.   Overall Horsepower Simulation % Error (OHPSE) - At the conclusion of each test, a violation occurs if the OHPSE is > 5%.

$$O/A\ HP\ \%\ Err.=\left(\frac{\sum(Achieved\ PAU\ Power)-\sum(Desired\ PAU\ Power)}{\sum(Desired\ PAU\ Power)}\right)*100$$

4.   Maximum Vehicle Speed - The dynamometer shall be designed to accommodate a vehicle speed of up to 60 mph.

~~1.1.5~~2.5.5   Rolls

a   *Main Rolls*

The dynamometer shall be equipped with twin rolls. The rolls shall be electrically or mechanically coupled side-to-side and front-to-rear. The dynamometer roll diameter shall be between 8.65 inches. The spacing between roll centers shall be determined by the following equation. The actual spacing shall be within +0.5 and -0.25 inches of the calculated value.

Roll Spacing = (24.375 + D) × Sin 31.52E

Where D = Roll Diameter and Roll spacing and roll diameter are expressed in inches.

b   *Roll Speed*

Roll speed and roll counter shall be accurate within 0.1 mph for speeds up to 60 mph. The side-to-side (split) rolls shall maintain speed synchronization of ±0.2 mph. Roll speed measurement systems shall be capable of accurately measuring a 3.3 mph per second acceleration rate over a one second period with a starting speed of 5 mph.

The total number of dynamometer roll revolutions shall be used to calculate the distance traveled. Pulse counters may be used to calculate the distance directly if there are at least 16 pulses per revolution. The measurement of the actual roll distance for the composite and each phase of the transient driving cycle shall be accurate to within ±0.01 mile.

c   *Track Width*

The dynamometer shall have a usable track width of at least 100 inches.

The dynamometer rolls shall have a minimum width of 96" and the space between the split rolls shall not exceed 30". Tire overhang, the distance from the end of the roll to the tire bulge when the tire is in the widest position, shall not exceed 2 inches. If, during vehicle stabilization, the tire attempts to push outside the usable width, tire/vehicle damage shall be prevented. Tire damage includes, but is not limited to, excessive scrubbing either against the dynamometer or the restraints. The dynamometer shall not damage any part of the vehicle during testing, ingress or egress under normal operation.

d   *Roll Characteristics*

The roll size, surface finish, and hardness shall be such that tire slippage is minimized, that water removal is maximized, that the specified accuracy of distance and speed measurements are maintained, and that tire wear and noise are minimized.

2.5.6 Dynamometer Calibration

The dynamometer shall be automatically calibrated. The RI2000 manufacturer shall demonstrate that the dynamometer calibration procedure stated yields negligible error when the parasitic losses curve is extrapolated to 60 mph. The difference between parasitic losses at 55 mph calculated by extrapolating the parasitic curve and the actual loss at 55 mph shall be less than 5%.

a   *Accuracy Over Operating Ambient Temperature Range*

The dynamometer's accuracy shall not deviate by more than ±0.5 hp over any temperature variation within the full ambient operating temperature range of 35^oF to 110^oF. This may be accomplished by intrinsic design or by software correction techniques.

At any constant temperature, the dynamometer shall have an accuracy of ±0.5 hp within 15 seconds of the start of the test, and shall have an accuracy of ±0.25 hp within 30 seconds of the start of the test.

The dyno manufacturer shall demonstrate that its dyno horsepower deviation between cold and warmed-up operation is less than 0.25 hp within an ambient temperature range of 35^oF - 110^oF.

The RI2000 dynamometers shall automatically compensate for changes in parasitic losses due to temperature variation. Instead of this requirement, the RI2000 manufacturer may provide a warm-up procedure for Program Administrator approval to ensure proper vehicle loading.

b   *Coast-Down Check*

Each dynamometer's calibration shall be checked every XX hours (configured by the HCS) by means of an automated dynamometer coast-down check procedure. An integral motor is required.

The clock used to check the coast-down time shall be accurate to the nearest 0.01 seconds when timing from 0 to 1000 seconds and shall have a display resolution of 0.01 seconds.

The coast-down performance check shall be conducted between the speeds of 30 and 10 mph. All rotating dynamometer components shall be included in the coast-down check. If either the measured 30-20 mph coast-down time or 20-10 mph coast-down time is outside the window bounded by Calculated Coast-down Time (CCDT) (seconds) ±7%, then it shall be locked out for official inspection purposes until recalibration allows a passing value.

1.   Randomly select an IHP value between 8.0 hp and 18.0 hp and set

$$CCDT_{@\ 25mph,yy} \ \ ' \ \ \frac{\left(\frac{0.5 \times DIW}{32.2}\right) \times \left(V_{30}^{2} \ \& \ V_{20}^{2}\right)}{550 \times \left(IHP_{yy} \ \% \ PLHP_{yy}\right)}$$

dynamometer PAU to this value. Coast down the dynamometer from 30 to 20 mph.

Where

DIW   =   Dynamometer Inertia Weight (total inertia weight of all rotating components in the dynamometer)

V_{30} =   Velocity in feet/sec at 30 mph

V_{20} =   Velocity in feet/sec at 20 mph

IHP_{yy} =   Indicated horsepower, randomly selected during each coast-down check

$PLHP_{yy}$ =   Parasitic horsepower for specific dyno at XX mph.

$$CCDT_{@\ 15mph,yy} \ \ ' \ \ \frac{\left(\frac{0.5 \times DIW}{32.2}\right) \times \left(V_{20}^{2} \ \& \ V_{10}^{2}\right)}{550 \times \left(IHP_{yy} \ \% \ PLHP15_{yy}\right)}$$

yy   =   Placeholder for dyno roll diameter

2.   Randomly select an IHP value between 8.0 hp and 18.0 hp and set dynamometer PAU to this value. Coast down the dynamometer from 20 to 10

mph.

DIW	=	Dynamometer Inertia Weight (total inertia weight of all rotating components in the dynamometer)
V_{20}	=	Velocity in feet/sec at 20 mph
V_{10}	=	Velocity in feet/sec at 10 mph
IHP_{yy}	=	Indicated horsepower, randomly selected during each coast-down check
$PLHP_{yy}$	=	Parasitic horsepower for specific dyno at XX mph.
yy	=	Placeholder for dyno roll diameter

c   Parasitic Losses

The parasitic losses in each dynamometer system (such as windage, bearing friction, and system drive friction) shall be characterized between 5 and 60 mph upon initial acceptance, and after each dynamometer load cell calibration. There shall be no sudden discontinuity in parasitic losses below 5 mph. The parasitic losses of the dyno shall be small enough such not to effect the emissions of the vehicle under test.

If the dynamometer is unable to pass the coast-down check, the dynamometer's parasitic loss horsepower (PLHP) shall be determined at 25, 20 and 15 mph.

Calculate the PLHP of the dynamometer at 25, 20, and 15 mph by coasting the dynamometer down with IHP set to zero from 30 mph to 10 mph, using the equation below.

$$PLHP ' ((½)(DIW/32.2)(V_{yy}^2 \& V_{xx}^2)) / (550 \times ACDT)$$

Where:

PLHP	=	Parasitic loss horsepower
DIW	=	Dynamometer Inertia Weight. Total inertia weight of rotating components in pounds.

For 25 mph:

V_{yy}	=	Velocity in feet per second at 30 mph.
V_{xx}	=	Velocity in feet per second at 20 mph.
ACDT	=	Actual coast-down time required for dynamometer to coast from 30 - 20 mph.

For 20 mph:

V_{yy}	=	Velocity in feet per second at 25 mph.
V_{xx}	=	Velocity in feet per second at 15 mph.
ACDT	=	Actual coast-down time required for dynamometer to coast from 25 - 15 mph.

For 15 mph:

V_{yy}	=	Velocity in feet per second at 20 mph.
V_{xx}	=	Velocity in feet per second at 10 mph.
ACDT	=	Actual coast-down time required for dynamometer to coast from 20 - 10 mph.

2.5.7   Other Requirements

a   Vehicle Restraint

The RI2000 shall be equipped with a means or device for restraining front-wheel-drive vehicles under test. Its primary function shall be to limit the vehicle's side-to-side movement on the dyno rolls. The restraint system shall be designed to minimize vertical and horizontal force on the drive wheels so that emission levels are not significantly affected. The restraint system shall allow unobstructed vehicle ingress and egress and shall be capable of safely restraining the vehicle under all reasonable operating conditions. Rear-wheel-drive vehicles shall have their front wheels securely chocked.

b   Installation

The RI2000 manufacturer is required to offer a dynamometer design accommodating both below grade and above grade installation. RI2000 systems will include ramps for up to 85% of all units delivered in RI at no additional cost. In all cases, installation must be performed so that the test vehicle is at a slope of no greater than five (5) degrees while on the dynamometer during testing.

The RI2000 manufacturer must also include all installation hardware that cannot reasonably be considered part of the facility modification to accommodate installation. The RI2000 manufacturer is responsible for providing installation of all units they supply. This includes:

·   Shipping,

- · Rigging,

- · Unloading,

- · Dyne placement, shimming, leveling and bolting,

- · Connection to power, air and data line service,

- · Assembly and assembly interconnections,

- · System run-up, checkout, debug and calibration.

Facility modification and/or improvement costs associated with the equipment installation will be the responsibility of the test facility business owner.

c   Load Measuring Device

If the dynamometer fails a coast-down check or requires a recalibration for any other reason, the load measuring device shall be checked using a dead-weight method, and shall cover at least three points over the range of loads used for vehicle testing. Dead weights shall be traceable to NIST, and shall be accurate to within ±0.5%. The dynamometer shall provide automatic load measuring device calibration/verification feature.

d   Wheelbase Selection

The wheelbase spacing of an all-wheel drive dynamometer shall be adjustable to accommodate vehicles having a wheelbase between 85 and 125 inches. The system shall provide a locking mechanism to secure the dynamometer at the desired wheelbase.

e   Automatic Lift

Dynamometers shall have an automatic lift between the rolls to allow smooth vehicle transition onto and off the rolls. Alternative methods of effecting this transition may be submitted to the Program Administrator for its approval.

The RI2000 system shall provide a safe procedure for removing the vehicle in case of system failure or power outage.

f   Driver's Aid

The RI2000 shall be equipped with a driver's aid that shall be clearly visible to the driver during the loaded-mode test. The aid shall continuously display the required speed, the number of seconds into the test mode, driver's actual speed/time performance (a display showing deviation between set-point and actual drive trace), engine rpm, and necessary prompts and alerts. The driver's aid shall also be capable of displaying test and equipment status and other messages as required.

g   Driver's Remote Control Device

Each RI2000 shall be equipped with a means of allowing the driver to start the test, perform an emergency stop, and perform other necessary and convenient functions related to the test, while inside the vehicle.

h   Fan

A fan shall be provided for cooling the engine of the vehicle under test. It shall be mobile or positionable in front of the vehicle, and adjustable in such a manner that the catalyst is not cooled abnormally. The fan shall have a maximum outer diameter of 30 inches. The fan must provide at least 3000 cfm or at least 10 mph air velocity averaged over the cross section of the fan, whichever is greater. The fan shall have an on/off switch. In addition, an optional remote control shall be offered which allows the Inspector to activate the fan from the driver's seat. The remote control may use software and/or hardware to activate the fan. The fan shall always be used when the ambient temperature is above $50^{o}F$, and may be used below that temperature.

i   Augmented Braking

Dynamometers shall be capable of applying augmented braking on major decelerations over 2 mph per second as required by the drive cycle. The dynamometer software shall provide a signal output to inform the operator when augmented braking is on. During periods of augmented braking the operator shall be made aware that augmented braking is occurring and shall be prompted not to use the vehicle accelerator during these periods. Augmented braking shall be automatically interlocked such that it can be actuated only while the vehicle brakes are applied.

Augmented braking shall be used during vehicle decelerations on the driving cycle. Augmented braking shall be actuated only when the negative force applied by the vehicle at the roll surface is greater than 110 pounds.

The RI2000 manufacturer shall provide written guidelines, for review by KTI or RI, to indicate how exactly augmented braking will be implemented.

j   Safety Provisions

Dynamometers shall have an automatic lift between the rolls to allow smooth vehicle transition onto and off the rolls. The RI2000 system shall provide a safe procedure for removing the vehicle in case of system failure or power outage.

k   Dynamometer Controller

The dynamometer controller may be a separate unit or included in the analyzer cabinet. Regardless, the dynamometer controller and its inputs, outputs and functionality shall not vary over the operating temperature range, and shall be unaffected by AC voltage variations of ±10% or less, EMI/RFI, and shall be resistant to shock and vibration.

l   Noise and Noise Mat

A vibration insulation pad for dynamometer installation must be supplied with each system. The pad shall be 1/8" thick. The mat at a minimum shall exceed the footprint of the dynamometer. The material shall be resistant to oils and antifreeze. Neoprene rubber can be used in this application. The surface shall be smooth. The mat shall have a minimum weight capacity limit of 8,500 pounds.

The RI2000 manufacturer shall submit noise data prior to certification based on a standardized test protocol.

m   *Emergency Stop*

Manufactures shall define "Emergency Stop" condition for their dynamometers. This procedure shall be available to the Program Administrator for review. It is the RI2000 manufacturer's responsibility to determine a safe method of conducting an "Emergency Stop".

2.6 Cabinet & Peripheral Requirements

All cabinets, including modifications are subject to Program Administrator approval and shall be tamper resistant as specified in §1.

~~1.1.1~~2.6.1   Power/Telephone Cord

The modem shall be designed to connect to the RI2000 by means of a modular telephone connector with a standard wiring configuration. The connector shall be located on the back of the analyzer cabinet. The telephone cord shall not be attached to the power cord. The telephone line shall be enclosed in a protective cable meeting Program Administrator and UL approval.

The manufacturer shall include provisions to ensure that the power necessary to activate the modem at the appropriate time is available.

The analyzer shall be supplied with a 25-foot UL-approved power cord. The manufacturer shall design the cabinet so that convenient storage is provided for the excess cord not needed to reach the nearest power outlet.

~~1.1.2~~2.6.2   Power Requirements

The RI2000 shall operate only on alternating current (AC). No direct current (DC) models will be acceptable. A portable AC generating unit shall not power the RI2000. The manufacturer may seek an exception to this rule if it can be shown, to the satisfaction of RI, that the analyzer is immune to the line frequency variations of the portable AC generating unit. Immunity to line frequency variations is defined here as line frequency variations which will not cause more than one percent of full scale (FS) disturbances on any of the analyzers. Additionally, any AC portable generating unit used with the RI2000 shall not have frequency excursions exceeding one hertz from 60 hertz.

Input power shall be 115 VAC, 60 hertz. All instruments shall meet the

specified requirements over an input voltage variation of at least ±12 volts. Maximum allowable performance change due to line voltage variations shall not exceed one-third of the accuracy requirements.

~~1.1.3~~2.6.3   *Instrument Construction*

The instrument shall be designed and constructed to provide reliable and accurate service in the automotive repair environment. The analyzer shall be supplied with a cabinet that is equipped with a storage area large enough to secure all accessories and operating manuals.

a   Materials

The materials used in instrument construction shall be resistant to corrosive type substances found in the automotive repair environment and be designed to last for at least the period of the warranty.

b   Finish

The exterior and interior finish of the entire cabinet and console shall be sufficiently durable to withstand the chemicals and environmental conditions normally encountered in the automotive repair environment for the period of the warranty.

c   Mobility

The analyzer may be permanently mounted or mobile with wheels. Wheels shall be at least five inches in diameter and have a locking mechanism capable of preventing movement on a 15o incline.

If mobile, the analyzer shall be designed so that movement over rough surfaces (three-inch deep holes) and on 15o inclines, will not cause it to tip over. Analyzers shall not tip over when placed at the center of an inclined plane that makes an angle of 10 degrees with the horizontal and rotated 360o stopping in the position where it is most likely to tip over. In addition, the analyzer shall not become unstable or tip over when rolled straight off the edge of a two-inch high platform or when one wheel is rolled over a drain, two inches below the surface, inside an 18-inch diameter depression.

d   Identification

The analyzer serial number, the date of production, and the RI2000 number shall be conveniently displayed to the quality assurance inspectors and the RI field representatives, in a manner meeting RI's approval. The first two characters of the RI2000 number shall be alphas denoting the manufacturer's initials, and shall not be changeable from the keyboard even in the manufacturer's service mode. The initials chosen are subject to approval by the Program Administrator. The remaining six characters shall be numeric. The numbers shall be right justified. Zeroes shall be used to fill any blank spaces between the initials and the numerics. For example, the RI2000 number for analyzer #23 from Hobo Electronics would be "**HE000023**." The RI2000 identification plate shall be located on the

outside of the cabinet.

e   Electrical Design

Provisions shall be made for storing the power cord in a manner satisfactory to RI. Fuses or circuit breakers shall be used to protect individual electrical circuits and emission analyzers. Main circuit breakers and fuses shall be readily accessible from the exterior of the cabinet. Analyzer operation shall be unaffected by electrical line noise and voltage surges. The analyzer shall be sufficiently protected from voltage surges to prevent damage to the analyzer from the simultaneous start up of a 220-volt compressor, an arc welder, hydraulic controls and other equipment commonly found in the typical automotive test and/or repair environment.

f   Electromagnetic Isolation and Interference

Electromagnetic signals found in an automotive environment shall not cause malfunctions or changes in accuracy in the electronics of the RI2000. The instrument design shall ensure that readings do not vary as a result of electromagnetic radiation and induction devices normally found in the automotive garage environment (including high energy vehicle ignition systems, RF transmission radiation sources and building electrical systems).

In addition, the manufacturer shall ensure that the analyzer processor and memory components are sufficiently protected to prevent the loss of programs and test records.

g   Vibration and Shock Protection

System operation shall be unaffected by the vibration and shock encountered under the normal operating conditions encountered in an automotive environment. Instruments, motors, pumps, and disk drives shall be shock-mounted to absorb any vibration that might affect the system operation.

h   Instruction Manual & Accessories Storage

A drawer and/or enclosed cabinet with shelves shall be provided to store the analyzer operating instruction manual, RI2000 Manual (expected to consist of two two-inch loose leaf binders), the RI Repair Manual (expected to consist of the equivalent of one two-inch binder), and RI2000 accessories.

2.7 Bar Code Scanner

The non-contact 1D bar code scanner shall be capable of reading both code 39 and 128 symbologies and all necessary interface software and hardware designed to read labels meeting SAE specifications J1877 and J1892 is required

on all analyzers**. The laser non-contact scanner shall be capable of reading 1D technology codes.

The bar code scanner shall be able to autodiscriminate between the symbologies. The bar code scanner shall be capable of reading a VIN through a windshield. The bar code scanner shall be capable of reading a bar code having a maximum length of 7¼" (seven and one quarter inches).

~~1.1.1~~2.7.1 *Minimum Required Configuration for Bar Code Scanner*

The analyzer shall be equipped with a standard port configuration and standard connector (such as DB9, CPC, or DB25 RS232C external connector) for the bar code scanner. Proprietary scanner systems will not be permitted. The bar code scanner will be used to load emission control system information from application manuals and from the permanent bar code labels placed on the vehicle by the manufacturer. The supplied bar code scanner shall come with at least a twenty (20) foot long self coiling cord and be able to read bar codes placed on the door frames and under the hoods. The manufacturer will be expected to include any software necessary to utilize the data gathered from labels.

2.8 Fuel Cap Tester

The RI2000 shall include a fuel cap testing system meeting the following specifications. The fuel cap tester may be provided separately but must provide the serial communication described below.

1	The fuel cap tester system shall test the leak rate of fuel caps to prevent evaporative emissions.
2	The system shall be designed so tethered caps can be accommodated without moving the RI2000 and shall be capable of pressurizing the fuel cap for this test. The pressurizing system shall apply a controlled pressure of 30 in. H_2O to the fuel cap. The system shall indicate fail if the leak rate is greater than 60cc per minute. The system shall indicate a pass if the leak down rate is 60cc or less per minute. The leak test shall not last longer than 20 seconds.
3	The system shall have the capability to change the leak rate pass/fail setpoint if needed at a later date.
4	The system shall be tamper resistant.
5	Fuel cap test equipment shall indicate a pass/fail condition.
6	The system shall have an indicator and/or screen prompt informing the Inspector when the system is ready to test

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The bar code scanner shall be of standard, "off-the-shelf" technology approved by Rhode Island.

(pressurized and power turned on).

7   The system shall have a means of controlling the maximum reservoir pressure and relieving overpressure.

8   If the system is battery operated, it must be equipped with an automatic shut-off and a low-battery indicator.

9   Data Transmission (for External Cap Tester Only)

The system shall be equipped with a serial data port and shall transmit pass/fail and calibration information to the RI2000 database via the data link.

a   RI2000 Communication Data Link

The fuel cap tester shall communicate with the RI2000 to record information such as pass/fail, calibration, etc. Communication and power to the unit shall be provided by one cable (if the unit is external). A CPC serial port as shown below, shall be used for communication and to provide the power needed to operate the fuel cap tester. Other methods of providing power and communication may be submitted to Rhode Island for approval.

b   The connector on the RI2000 and pin outs shall be as follows:

ANALYZER CPC REVERSE CONNECTOR

This connector must be compatible with an AMP 211398-1. The CPC ports will supply software switchable 12V DC to equipment attached. The 12V pin shall be protected for power surges over .5 AMPS. The circuit protection shall be easily accessible to the Inspector unless it is an automatic reset system. The pin-out shall be as follows:

PINS	SIGNAL
1	GND
2	+12v
3	RTS................RESET (request to send)
4	RESERVED (open)
5	SHIELD - GND
6	TXD...............TRANSMIT DATA
7	RCV...............RECEIVE DATA

The power for the system will be provided via the CPC connector as shown above.

NOTE: No serial interface cable shall exceed 35 feet unless it has been demonstrated to Rhode Island that sufficient shielding has been provided to prevent radio frequency interference (RFI).

c   Calibration and Accuracy

1   Each system will have a calibrated screened orifice PASS/FAIL MASTER cap set. The set shall be individually calibrated; the calibration shall be traceable to the NIST. The master cap set shall consist of a PASS MASTER flowing 52 to 56cc per minute and a FAIL MASTER flowing 64 to 68cc per minute (both measured at 30 in. H_2O pressure). The system shall be checked at the frequency indicated by the NETWORK.DAT with the master calibration caps. This check shall be system user executed and shall be required via software. The calibration caps shall be calibrated before initial usage and on an annual basis unless quality control tracking that suggests less frequent intervals are appropriate. Annual calibrations shall be conducted by the manufacturer's field service representatives. The calibration method shall be NIST traceable. Equipment out of calibration may not be used.

2   The system accuracy shall be accurate to within ±3cc per minute and shall be capable of maintaining its accuracy from 35° to 110^oF and at elevations from -60 to 7,000 feet.

d   Adapters

1   The system shall be capable of testing at least 95% of the Rhode Island motor vehicle fleet (excluding pressurized fuel systems such as CNG, LPG, etc.) that are equipped with evaporative control systems.

2   Adapters shall be made available within two years of the introduction of new model-year vehicles.

3   Adapter set shall have a means of indicating which vehicles they fit.

2.9 Engine RPM Detection

The analyzer shall utilize a tachometer capable of detecting engine RPM with a 0.5 second response time and an accuracy of ±3% of the true RPM. Prompts may be provided to assist the Inspector in locating a RPM signal on vehicles equipped with DIS. Based on the vehicle identification information entered by the Inspector, the analyzer shall advise the Inspector regarding which vehicles require a primary pick up, which require that an alternate counting algorithm be used and which require the use of an auxiliary piece of equipment. Analyzers shall be provided with all the software and hardware that is necessary to make them capable of reading engine speed on all vehicles manufactured prior to analyzer certification that are included in the I/M Program (except those powered by diesel engines).

As a minimum, analyzers must be equipped with a spark plug wire direct pickup, a

non-contact pickup, and an OBD-II interface connection. The system shall be capable of detecting engine RPM via OBD-II.

Note: The system shall enable the user to use any device without disconnecting the other. All RPM detection methods must be connected to the RI2000, simultaneously. A manual hardware switch (software switch is preferred) may be installed for the operator to determine selection of detection method.

2.10   Accessing OBD Fault Codes

The analyzer manufacturer shall provide a means of retrieving fault codes from vehicles with on-board diagnostics II (OBD-II) using the SAE Standardized Link. The SAE Standardized Link shall connect to the vehicle's on-board diagnostics port to automatically interrogate and retrieve fault codes.

2.11 Testing heavy-duty Gasoline-Powered Vehicles

The manufacturer shall supply the analyzer with the hardware and software necessary to test heavy-duty gasoline-powered vehicles. At a minimum, accessories shall allow for 40-foot motorhomes to be tested without degrading the emission analyzer response time and provide the Inspector with an accurate indication of the engine speed. Vehicles with >8,500 GVWR shall be tested using the two-speed idle mode.

3   RI2000 SOFTWARE SPECIFICATION

3.1 Overview

Section 3 specifies the software requirements for RI2000 emission inspection systems (RI2000). It includes inspection procedures, sequences, decisions, responses and prompts, as well as necessary information to be loaded, security issues, lockouts, file structures, etc. It also contains requirements for communication with the Rhode Island's Host Computer System (HCS).

~~1.1.1~~3.1.1   *Major Software Functions*

Software in the workstations will drive the following major functions:

- Leading inspectors through each step of any required safety or emissions inspection procedure to ensure that they are accurately followed. A help feature will be available in the software.

- Automatically determining the appropriate inspection required for each vehicle to be tested.

- Initiating calls and communicating with the host, to transmit all available data on the vehicle to be tested from the HCS.

- Monitoring and controlling workstation functions during all stages of training, inspection and diagnostic processes, etc.

- Regulating the testing based on compliance with established QA standards.

- Monitoring workstation switches to detect possible system tampering.

- Monitoring calibration status as well as initiating and facilitating system calibrations.

- Collecting all inspection, calibration and system records and transmitting them to the host after the inspection.

- Monitoring and controlling the inspection of vehicles at such times as communications with the host are not available.

- Transmitting all inspection data accumulated during off-line operations to the host, as soon as communications are restored.

- Monitoring, controlling and facilitating the electronic transfer and inventory of paid test authorizations.

- Facilitating receipt and display of bulletin information from the host computer system.

- Accounting for fees collected in relation to safety and emissions testing.

- Facilitating interface with optional diagnostic equipment.

- Printing out Vehicle Inspection Reports and other related documents.

- Deter fraud

3.1.2 *Promote Safety*

The workstation software will help to promote a safe environment in a variety of ways including:

- Delivery of reminder massages regarding safe operating practices such as using vehicle tie downs and wheel chocks, checking to verify motorist is in a proper waiting area, ensuring all exhaust is removed from the building, and so forth.

- Control of dynamometer interlock functions to disable lifts when wheels are rolling.

- Facilitation of emergency abort function to enable the test to be interrupted if there is a safety hazard.

3.1.3 *Statistical Diagnostic Messaging*

In addition to supporting the various diagnostic options available with the workstations the workstation software will utilize the KTI Statistical Diagnostic Messaging (SDM) system. The statistical diagnostic message system will provide statistical diagnostic information for transient mass emission testing for gasoline fueled vehicles.

The SDM system shall reside on the RI2000. The files used in this system shall be updated from the HCS. This analysis is performed on failing constituents only.

The SDM will operate in the following manner:

a   Mode Measurement Determination

The mass emissions measured in the final transient drive cycle shall be separated into four modes for each failing constituent:

> A –   Acceleration emissions
>
> D –   Deceleration emissions
>
> C –   Cruise emissions
>
> I –   Idle emissions

The continuous time period during a drive cycle that is considered the mode period shall be supplied in the following manner:

Drive Cycle	RI31 Mode Times
Start Idle	0
End Idle	4
Start Acceleration	5
End Acceleration	15
Start Cruise	17

End Cruise	21
Start Deceleration	22
End Deceleration	30

Mode Measured =   Total of measured emission mass during period described above.

b   *Mode Ratio*

Mode Ratio = Mode Measured divided by the cutpoint for that constituent.

c   *Fail Mode*

Fail Mode = True if Mode Ratio > HCS Fail Limit

Mode	**Variable Name in NETWORK.DAT**
A	Acceleration fail limit
D	Deceleration fail limit
C	Cruise fail limit
I	Idle fail limit

Failing components shall be indicated in the SDM fail mode (HC, CO, NO) fields in TEST.DAT.

For a failing component, if there are no Fail Modes = True, then the Fail Mode shall be automatically set to E = "General". For a failing constituent, if there are multiple Fail Modes = True, then the Fail Mode shall be automatically set to E = "General".

The DECISION.DAT table, updateable from the HCS, shall be used to determine which text messages numbers to select from the SDM database based on the failure mode. This information shall be passed from the HCS in the DECISION.DAT file. The default table is as follows:

Failed Component	Fail Mode	Message Pointer #1	Message Pointer #2	Message Pointer #3
HC	E	10	14	-
HC	A	11	10	15
HC	D	12	10	16
HC	C	13	10	17
HC	I	50	51	52

CO	E	20	24	-
CO	A	21	20	25
CO	D	22	20	26
CO	C	23	20	27
CO	I	53	54	55
NO	E	30	34	-
NO	A	31	30	35
NO	D	32	30	36
NO	C	33	30	37
NO	I	56	57	58

The Message Pointer # indicates the Message Number required for search in SDM.DAT.

d   Determine Message

1   Based on the message number determined using DECISION.DAT, the statistical text messages will be found in SDM.DAT.

2   Based on the SDM Locator, failed component and mode, the RI2000 shall query the SDM table for a match.

3   The RI2000 shall try to locate Message Number indicated by Message Pointer #1. If not found, the RI2000 shall search for Message Number indicated by Pointers #2 then #3.

4   The RI2000 shall select only one message for each constituent failure.

5   If a match is found, the text message shall be printed on the VIR. In addition, the following disclaimer shall be printed every time a SDM message is provided:

SDM Disclaimer Notice:
Disclaimer: The following information is provided for informational purposes only and may not indicate an actual vehicle problem. No repairs should be performed based solely on this information.

6   If no message is found then nothing associated with SDM shall be printed on the VIR.

7   The following SDM text symptom shall be printed for each constituent (HC, CO, NO) and fail mode (acceleration, deceleration, cruise, idle):

For Acceleration, Deceleration, Cruise, Idle failure: "Your vehicle has failed the emissions test for (HC, CO, NO) during the (acceleration, deceleration, cruise, idle) portion of the drive cycle."
For General failure: "Your vehicle has failed the emissions test for (HC, CO, NO) during the drive cycle."

e   *SDM Update*

During an SDM Update, records will be replaced or appended as necessary, based on SDM Locator(s). For example, during an SDM update, for SDM Locator number 20,000, all local SDM records with Locator number 20,000 will be replaced with a new set of records, regardless of other variables such as message number.

~~1.1.4~~3.1.4   Security

Within the RI2000 software, algorithms, requiring the use of an access code, will be utilized where appropriate. Should any tampering occur, a software lockout algorithm will be activated that aborts any existing test sequence and prevents further I/M inspection testing until the lockout is cleared by authorized personnel.

~~1.1.5~~3.1.5   Y2K COMPLIANT

a   *Warranty*

The manufacturer must warrant that software and hardware supplied pursuant to the equipment supply Contract shall function such that before, on and after January 1, 2000, such software and hardware:

1   Handle any date information and can differentiate between the twentieth and twenty-first centuries;

2   Shall function accurately without interruption;

3   Process date and/or time data (including, but not limited to, calculating, comparing, and sequencing from, into and between the twentieth and twenty-first centuries and the years 1999 and 2000);

4   Store and process date output specific to the century;

5   Manage all leap year calculations including the leap-year in 2000, following the quad-centennial rule;

6   Adhere to International Standards Organization standard

8601 for date format; and

7   Respond to two-digit year date input in a way that resolves uncertainty as to century.

b   Date/Time Exchange

Furthermore, the manufacturer must warrant that software and hardware supplied pursuant to the Contract, when used in combination with other information technology, shall process accurately date/time data if the other information technology properly exchanges date/time data with it. This warranty shall survive the expiration or termination of the equipment supply Contract.

1̶.2̶3.2 RI2000 Software Components

3.2.1 General

The program software used in the RI2000 shall consist of a process control system as well as data look-up files. The software consists of inspection test procedures and criteria; necessary station, inspector, and vehicle information; security measures, utilities and ancillary modules. Its features include vehicular emission measurements of HC, CO, CO_2, NO and O_2, engine RPM measurements, exhaust dilution determinations, bar code scanning, OBD-II scanning, gas cap testing, interface with a dynamometer, communication to and from the HCS, etc.

1̶.1̶.2̶3.2.2   Boot-up Configuration

On each POWER ON, the RI2000 shall automatically self-diagnose all computer systems, including memory checking, hard disk and loading of all necessary operating software without inspector intervention. If any corruption is found on the hard disk during the hard disk check and if check files are saved (usually saved as *.chk files), then the check files must be deleted so that the hard disk will not contain an excessive number of these files. Upon satisfactory computer component checkout (including hard disk data structures), the application software shall present a menu of available RI2000 operations. All offered features shall be menu-driven. For Inspection related features, context-sensitive, on-line help shall be provided which can be accessed preferably with a single keystroke.

1̶.1̶.3̶3.2.3   Software Modifications and Software Update Certification

Periodic software updates will be necessary. Software updates may be required by KTI, Rhode Island, or the manufacturer. In any case, the manufacturer is responsible for installing the software and ensuring its proper operation in their respective RI2000 units throughout the State at no additional cost to the State, Keating or the user.

Design and development costs associated with the software updates are the responsibility of the manufacturer if the update is required by the

manufacturer for its own purposes or to achieve performance to specifications.

The manufacturer must provide up to 1500 man hours of software development for KTI requested changes at no additional charge to KTI or Rhode Island or the user. The RI2000 manufacturer shall provide an estimate of man hours required to complete the requested changes. The estimate shall be submitted to KTI for approval within 15 days of receiving the requested changes.

Updates to the software specifications will be provided to the manufacturer by Keating. The manufacturer shall provide the software code to KTI upon each update. The software version number is to be indicated on the RI2000 status screen, on each vehicle test record and the VIR. The version number shall consist of a four digit numeric code to be made up of the last two digits of the year, followed by a two-digit version number.

All software updates shall cause the software version number to change. To maintain the integrity of Rhode Island's I/M program, QA and RI field personnel will be instructed to lock out RI2000s that have unauthorized modifications or are running unapproved software versions. Keating and RI may independently test software upgrades. The following criteria apply to software and software updates:

a   *Third Party Software*

Only Rhode Island/KTI-approved software shall be used in the RI2000. Rhode Island intends to accommodate software developed by third parties as long as system security and integrity are not compromised. In addition, Rhode Island may initiate the development of software updates by third parties for use in all RI2000. If Rhode Island initiates development of a software update, manufacturers shall cooperate with Rhode Island and/or the Rhode Island-approved third party.

b   *Software Update Requirements*

1   All proposed software updates must be thoroughly tested by the manufacturer before being submitted to Rhode Island/KTI. Update disks as well as electronically transmitted updates shall be encrypted in a manner approved by Rhode Island. The RI2000 shall be capable of accepting software updates via CD and floppy disk.

2   All proposed software updates generated by the manufacturer shall be submitted to Rhode Island with a written description of the reason for the update, such as the problem that the update corrects. Any update of this nature shall not be applied towards the 1500 man hours of software updates due to RI, as described in this section.

c   *Software Update Submittal Procedure*

All proposed software updates, including manufacturer-generated updates, must be submitted to KTI/Rhode Island for testing and approval. Guidelines for this procedure follow:

1   Software updates must be submitted on a mutually agreed upon medium.

2   Each new software version submitted to KTI/Rhode Island, including minor revisions, must have a new and unique software version number.

3   All proposed software updates must be accompanied by a cover letter with the following information:

i   A description of all of the changes contained in the proposed software update, including manufacturer-initiated modifications.

ii   A timeline of when the update is expected to be installed (start to finish) and how many units will be updated.

iii   If any hardware modifications or special procedures are needed to perform the software update, describe the procedures for performing the update.

iv   All proposed software updates for the RI2000 should be accompanied by a data disk containing at least 50 total records for both transient and Two-Speed Idle tests as shown in Table 1 below.

TABLE 1 – REQUIRED TEST RECORDS

TEST RECORDS	# OF RECORDS

	Loaded	Non-loaded
PASS	5	3
FAIL (HC, CO, NO)	5	0
FAIL (HC, CO)	3	3
FAIL (HC, NO)	3	1
FAIL (CO, NO)	3	1
Fail Diesel	6	3
Fail Safety	5	3
FAIL (Functional)	2	2
TOTAL RECORDS	34	16

v   The data disks shall also contain at least 10 complete calibration records.

vi   The records must be generated by the RI2000 and should include all items required.

vii   Depending on the type and number of changes contained in the proposed software update, Rhode Island may require testing at KTI/Rhode Island-approved beta sites prior to release of the software. KTI/Rhode Island may perform a preliminary review of the proposed software prior to releasing it for beta site testing.

d   *Software Update Timeframe*

Manufacturers are allowed 30 business days to develop, test, and submit software updates/fixes that require less than 300 man-hours. Manufacturers are allowed six months, from the date Rhode Island issues its proposed specifications for periodic software updates, to obtain approval that the updates meet the proposed specifications and to install the updates in all RI2000 subject to the updates. The six-month time limit is based on changes requiring more than 300 man-hours and less than 1500 man-hours. During the first 30 days of the six-month period, the manufacturers shall be permitted to review and to comment upon the proposed specifications. However, a shorter period of time may be required by KTI/Rhode Island upon finding that a previously installed update did not meet the specification.

A manufacturer's failure to furnish or install software updates as so specified is cause for the Program Administrator to decertify the

manufacturer's equipment and hold the manufacturer in breach of their supply contract.

e   *Upgrade Clarification*

The manufacturer is required to provide 1500 hours of development from each workstation manufacturer to make upgrades to the software on the workstations at the request of KTI. The basis for determining an upgrade to the software on the workstations is the version of software accepted by KTI and RI, and any conditions placed on such acceptance, based on the acceptance test results.

The following types of changes will not be considered requested upgrades:

1.   Changes to the software that are required to meet the acceptance criteria

2.   Changes to correct defects in the workstation manufacturer software.

3.   Changes to accommodate hardware changes.

4.   Changes to maintain compatibility with upgrades to the workstation operating system or other component of the workstation.

The acceptance criterion for workstation software is passing the acceptance test in accordance with the Acceptance Testing Plan (ATP). The acceptance test will be based on the software functions as defined in the RI2000 specifications.

f   *Relevant System Testing*

The test cases presented must be relevant to the software changes made. Manufacturer testing should include safety only tests. Manufacturer tests must include any other documentation or test cases relevant to the software changes made (for example, if changes are made to the QA menu functions, documentation of tests on the functions must be provided).

(Reserved – Requirements will be defined for start up implementation.)

1.1.4̶3.2.4   *Running Changes and Other Software Modifications*

Any changes to design characteristics, component specifications, and any modifications to the software must be approved by the Program Administrator. It will be the manufacturer's responsibility to confirm that such changes have no detrimental effect on the performance of the RI2000.

1.1.5̶3.2.5   *Virus Detection Software*

Each RI2000 unit shall contain a virus detection program, subject to Program Administrator approval, which shall verify the integrity (i.e. check for infection/corruption) of each update disk or decompressed file before it

is applied to the RI2000 or allowed in memory. Infected/corrupted software shall be blocked from installation.

In lieu of this requirement, the RI2000 manufacturer may submit for Rhode Island's consideration written procedures clearly illustrating how the RI2000 manufacturer intends to meet the intent of the VIRUS PROTECTION PROGRAM requirement. These procedures shall demonstrate how the integrity of the RI2000 software and update software or decompressed file shall be protected under all circumstances.

~~1.1.6~~3.2.6   Directory and File Structure

(This information is confidential and may only be released with prior written consent and award of equipment contract from Keating Technologies. The Summary Sheet indicates in which directory the files will be stored.)

~~1.1.7~~3.2.7   Vehicle Look-Up Table and Diesel Look-Up Table (VLT and DLT)

The Vehicle Lookup Table is the Rhode Island's version of the EPA Vehicle Lookup Table (VLT). The VLT provides basic vehicle descriptions as well as transient testing parameters.

The Diesel Lookup Table is the Rhode Island's Diesel Vehicle Lookup Table (DLT). The DLT provides basic vehicle descriptions for diesel vehicles.

The following applies to both tables:

a   *Revisions*

The table will be periodically revised on a "by-record" basis. The RI2000 shall send the version date and the number of records in its VLT/DLT file to the HCS during any "Begin-Test" or "Data-Refresh" communications session.

b   *System File Updates*

When a "VLT/DLT Update" file is received from the HCS, the RI2000 shall store the file to the hard drive until a period of relative inactivity (e.g. between inspections). VLT.DAT/DLT.DAT file update strategies shall be proposed by each RI2000 manufacturer and be approved by Rhode Island. Each VLT/DLT update record will be preceded by a single character and shall be processed as follows:

"C" = replace record (same row ID),

"A" = append record (new row ID),

"D" = delete record (same row ID).

c   *Corrupt Files*

The VLT/DLT Update file may appear to be corrupted if either of the following conditions exist:

1   The version date sent by the RI2000 does not match any dates stored in the "VLT/DLT Update History" table in the HCS (second consecutive occurrence).

2   The number of records in the RI2000's VLT/DLT.DAT does not match the appropriate number of records for that version date (determined at the HCS).

If possible corruption is detected by the HCS, the HCS will send a lockout to the RI2000. The RI2000, upon receiving the response bit, shall display the following prompt:

DISPLAY PROMPT:

THE VLT/DLT DATABASE IS CORRUPT. CALL SERVICE.

If the VLT/DLT is corrupt, a lockout shall be set. This lockout can only be cleared by the HCS upon replacing the file and the HCS has verified that the VLT/DLT data has been replaced.

d   VLT Parametric Variables

The VLT table will contain additional parametric variables to be used during the emission test sequence. The test parameters shall be used to determine the test sequence. If any of the following fields are populated, the test sequence indicated by the NETWORK.DAT shall be modified for the vehicle under test:

- # of Preconditioning Transient Drive Cycle

- # of Official Test Transient Drive Cycle

- # of Postconditioning Transient Drive Cycle

- Second Chance Type

- Second chance decline %

- second chance cutpoint %

In addition, the VLT will contain the Prevent Testing on Dyno field which is used in the Testing Preparation section.

The VLT also contains the TSI Test Sequence. If a TSI test is required AND this field is populated, the specified TSI test sequence shall be performed.

1.1.8̶3.2.8   *Repair Action Information*

The RI2000 shall display a list of all repair categories and prompt the inspector to select the category or categories of the system(s) which were repaired. The inspector must be able to return to the list of major

categories after each subcategory has been completed without having to hit more than two keys. Appendix II contains the repair form data sheet.

All repair actions shall be documented on the vehicle inspection report (VIR), and stored in the repair record. The inspector shall be required to sign on the VIR to document the repairs that have been performed to reduce emissions. If further repairs are needed, the estimated cost of the additional repairs shall be printed on the VIR and recorded in the Estimated Cost of Additional Repairs field of the repair record.

A retest shall be performed even if the repair information is not available.

~~1.1.9~~3.2.9 *Display*

a *Readability*

The display, when in the test mode, shall be readable at a minimum distance of twelve feet in a building that meets OSHA lighting standards for a garage environment. Display contrast and brightness shall be adjustable.

b *Rhode Island Messages*

Rhode Island messages shall be transmitted by the HCS to the RI2000 during all communication sessions except during the network diagnostic routine (loop back). Rhode Island messages will be in text file format. All new messages shall be displayed immediately after the inspector selects Inspection from the main menu. The RI2000 shall display these messages one-time-only and shall provide an option to print. All displayed messages shall default to print and the inspector must press a function key to continue.

c *Testing Messages*

During the emissions test, the RI2000 shall display the word TESTING on the screen. The RI2000 shall also display messages such as test mode, vehicle speed, dynamometer load deviation, excessive exhaust dilution, low flow, driver acceleration violations, and engine RPM violations.

d *Information Not Permitted During Testing*

The RI2000 shall not display the emission readings during the inspection. (However, during manual mode, the readings shall be displayed.)

e *Print Screen Capability*

The RI2000 shall have a PRINT feature, which prints any current text or graph displayed on the screen, by depressing no more than three keys. The print feature shall always be active; however, there shall be no print capability during emissions testing.

f *Vehicle Speed and Engine RPM*

The RI2000 shall display either the vehicle or engine speed depending on emission test selection.

~~1.1.10~~3.2.10 *Training Mode*

The RI2000 shall have a TRAINING MODE feature that will allow an inspector or student to go through the complete inspection procedure. This capability will be used by the manufacturer or KTI to train system users or by RI2000 owners to train new employees, or for schools to train students. The training mode shall not require the use of an inspector's access code or allow access to secured areas of hardware or software and will not communicate to the HCS. The display shall show a message throughout the inspection that this is a training exercise and not an official test (no test authorizations shall be issued). A sticker will not be issued in this mode. The RI2000 shall print TRAINING and VOID on the VIR. Training data shall not be transmitted to the HCS.

~~1.1.11~~3.2.11 *Payment Functions*

Workstation software is required to facilitate control of system use based upon payment status information transmitted from the host. System users will be required to pay a monthly payment as well as a per test fee to KTI for use of the equipment and for program services such as data processing, quality assurance and public awareness. KTI requires per test fees and monthly payments to be paid in advance. This payment will trigger transmission of test authorizations to the workstations from the host. Workstation software will be required to disallow official inspections without prior receipt of valid test authorizations from the host.

There are two types of test authorizations. The first corresponds to inspections issued with a 1-year sticker; the second corresponds to inspections issued with a 2-year sticker. The fee for each type of authorization is configurable through the HCS (NETWORK.DAT), and the authorizations corresponding to the 1-year sticker shall be used only until MMDDYYYY, ~~a date configurable through the HCS~~ (Begin Biennial Inspection Date in NETWORK.DAT).

The analyzer shall have the ability through the Station Manager Menu to initiate orders for test authorizations. The system shall allow the manager to order multiple batches of test authorizations at a time. Only one order may be sent at a time, and the HCS may limit the number of test authorizations that may be sent to the analyzer. The number of authorizations per batch for each type of authorization shall be configurable by the HCS.

The purchase transaction can occur even if the RI2000 is locked-out from testing. Station payments for annual station renewal shall be handled outside the scope of the workstation. However, the Monthly Payment Expiration and Station License Expiration Dates will be sent to the analyzer by the HCS so that the appropriate warning messages may be displayed. The system will provide:

- Warning at station manager set levels for low test authorizations at the start of every test when the threshold is reached

- Warning for monthly payment expire date

- Warning for station license expire date

- Status on test authorizations on hand

The RI2000 shall print:

- Receipt of test authorizations received from the HCS

- Monthly Billing Statement Report

3.2.12 Configuration Information

a *NETWORK.DAT*

The RI2000 shall receive network configuration information from the HCS. Network configuration default information is contained in NETWORK.DAT.

b   *CONFIG.DAT*

The RI2000 shall receive RI2000 specific hardware configuration information from the FSR. RI2000 configurations are described in RI2000 CONFIG.DAT, in the RI2000 Hardware Configuration field. The specific hardware required for each configuration is defined in Section 2 (Hardware) - Workstation Configurations.

EMISSIONS TEST EQUIPMENT	VEHICLES TO BE INSPECTED	RI2000 HARDWARE CONFIGURATION
TRANSIENT LOADED MASS, TWO SPEED IDLE, OPACITY (LOADED, NON-LOADED) ACCELERATION	ALL VEHICLES	1
TRANSIENT LOADED MASS, TWO SPEED	ALL VEHICLES EXCEPT ALL DIESELS	2
TWO SPEED, OPACITY (SNAP ACCELERATION)	ALL VEHICLES THAT DO NOT REQUIRE DYNO TESTING	3

The RI2000 system shall permit testing only if the system configuration is appropriate for the test required.

DISPLAY PROMPT:

THIS VEHICLE REQUIRES A TEST THAT CAN NOT BE PERFORMED ON THIS SYSTEM.

~~1.1.13~~3.2.13 *Additional Transient Mode Parameters (AVGCYCLE.DAT)*

The following information will be contained in the AVGCYCLE.DAT file.

- AvgHC (grams/mile) – This is average emission for the transient drive cycle for that VLT ROW ID. This information is printed on VIR for failing vehicles

- AvgCO (grams/mile) - This is average emission for the transient drive cycle for that VLT ROW ID. This information is printed on VIR for failing vehicles

- AvgNO (grams/mile) - This is average emission for the transient drive

cycle for that VLT ROW ID. This information is printed on VIR for failing vehicles

- Fuel Economy limit - Described in Transient Loaded Mode Testing Sequence section.

AVGCYC Update

During an AVGCYC Update, records will be replaced or appended as necessary.

1.1.143.2.14 *HCS Communication*

The Electronic Transmission (ET) system required for Rhode Island is an electronic communication network that enables an analyzer at a vehicle testing station to receive and transmit data to and from the host computer system (HCS). All connections from the analyzer will be made via asynchronous dial-up through a serial port. When the analyzer needs to receive or transmit data to or from the HCS system, the connection must be automatically initiated by the workstation for the user without user intervention. The programming required at the workstation to interface with the HCS will be integrated with the workstation software. It will be maintained and supported by the RI2000 manufacturer.

Data transmission will occur through a minimum of one dial-up connection associated with each vehicle inspection.

The workstation provider is required to work in cooperation with KTI to develop a communication protocol specification.

1.1.153.2.15 *Safety Inspection*

This is primarily a software controlled, manual procedure involving user prompting for procedural steps and keyboard or wireless remote device entry of safety inspection results. The Rhode Island safety inspection regulation requirements must be met.

1.1.163.2.16 *Repair Information*

The workstation must accommodate collection of repair information for failed vehicles and transmission of that information to the host computer. The workstation will be required to support this process by:

- Facilitating collection and transmission of repair data,

- Printing graphic representations of the failed vehicle second by second mass emissions results on VIR,

- Printing graphic representations of typical passing vehicles of like kind on VIR,

- Printing text diagnostic messages derived from the KTI diagnostic database on VIR.

3.3 Software Modules

3.3.1 *Inspector and Station License Numbers and Other Numbers*

a   *General:*

The inspector's license number and access code shall reside in both the RI2000 and the HCS. The RI2000 shall determine the validity of the inspector's license number and access code~~, and the HCS shall confirm the validity of the license number at initial contact~~. The inspector table shall be updated by the HCS by complete table replacement.

In addition, the RI2000 shall not be allowed to go into the inspection mode unless valid entries have been made for station number, calibration gas values, test authorization numbers, stickers and at least one licensed inspector.

The RI2000 shall have the capacity to store at least 25 inspector access codes and the corresponding Inspector License numbers. Only the HCS can add, change or delete the inspector's access code and corresponding license number.

b   *Inspector License Numbers:*

The RI2000 shall automatically abort the function and display a message indicating that the inspector has not obtained the proper ~~inspection class and/or~~ training level. The TECH.DAT shall contain the following information:

1	INSPECTOR LAST NAME
2	INSPECTOR FIRST NAME
3	INSPECTOR MIDDLE NAME
4	ACCESS CODE
5	LICENSE NUMBER
6	EXPIRATION DATE
7	TRAINING LEVEL

~~8INSPECTION CLASS~~

Space for at least 25 licensed inspectors shall be provided. Alternative arrangements of the information will be considered by the Program Administrator.

c   *Inspector Access Codes:*

The RI2000 shall require the inspector to enter a special access code before an inspection can begin. The access code shall neither be displayed nor printed on the VIR. This special access code number shall be linked to the inspector's license number.

d   *Station License Number:*

The station license number shall be entered into the RI2000 during

initialization in the FSR menu. Only valid station license prefixes may be entered into the RI2000.

The 8-character Station Numbers are alphanumeric and unique to each station. The station license number shall be placed in the Station License Number field of the test record and on the VIR. This field must be populated in the test record for every valid test record sent to the HCS.

Fleet stations shall have license number format Fxnnnnnn.

e   Test Record Number

The RI2000 shall give each valid test a consecutive number. A valid test consists of a completed test with an overall pass or fail test result that shall be transmitted to the HCS. The record number shall be written to Test Number field of the test record. This field is numeric and has a length of 6 digits. When the number reaches 999999, the number shall be reset to 000001. This field must be populated in the test record for every valid test record sent to the HCS.

f   RI2000 Number

The RI2000 number shall be unique for each RI2000 unit in Rhode Island. The 8-character alphanumeric number shall be unique to each RI2000 made by a manufacturer. The RI2000 number shall be written to the RI2000 Number field of the test record. This field must be populated in every valid test record sent to the HCS. Print the RI2000 number on the VIR.

g   Loaded Software Version Number

This field shall contain the version number of the software that is currently being used by the RI2000. The loaded software version number shall be written to the Loaded Software Version Number field of the test record and printed on the VIR. This field must be populated in the test record for every valid test record sent to the HCS.

h   HCS Identification

The HCS-ID is a record identifier generated by the HCS. The HCS shall assign an ID number to a test record which shall be transmitted to the RI2000 at the time of the begin test call. The ID will be written to the HCS-ID field of the test record. The HCS-ID shall not be modified by the RI2000 and shall be transmitted back to the HCS in the test record.

i   Transaction Identification Number

The Transaction Identification Number (TIN) shall be printed only if the vehicle passes the inspection. The TIN provides external validation of the authenticity of an inspection VIR or sticker without connection to the HCS host. The TIN encodes and decodes according to strict rules and ties the inspection to the inspection location and vehicle. The TIN provides

protection from forged documents. The formula for creating the TIN is a confidential document and shall be delivered, on request, only to the approved workstation manufacturer.

~~1.1.2~~3.3.2   *RI2000 Lockout Reasons*

a   Lockout List

All lockout reasons shall be displayed when inspection is selected. In the table below, the bolded lockouts are sent to and received from the HCS. If any of the non-bolded items are locked out, the bolded parent, if applicable, shall be locked out and sent to the HCS.

The manufacturer shall have a designated area in which to store a flag, to be set when a new tamper is detected since the previous test. Once the tamper is cleared, and a test is completed, the Tamper Since Last Test field in TEST.DAT shall be set to "Y", and the new tamper detected since last test flag shall be cleared.

All lockouts do not affect all tests. The RI2000 shall be prohibited from performing the listed inspections for the specified lockouts listed below, as represented by the LOCKOUT.DAT file:

Lockout Type	Common	TSI & Safety	Non-Loaded Diesel & Safety	Transient & Safety	Loaded Diesel & Safety
QA/State Lockout	x	x	x	x	x
Analyzer Hardware Lockout	x	x	x	x	x
Cabinet Tamper Lockout (tamper location must be specified)	x	x	x	x	x
VMAS Tamper Lockout				x	
No Contact Limits Lockout	x	x	x	x	x
Station License Lockout	x	x	x	x	x
No test authorization in inventory	x	x	x	x	x
Failure to pay	x	x	x	x	x

required payment					
Invalid Software Version	x	x	x	x	x
VLT Corruption Error		x		x	
DLT Corruption Error			x		x

Lockout Type	TSI & Safety	Non-Loaded Diesel & Safety	Transient & Safety	Loaded Diesel & Safety
QA/State Lockout	x	x	x	x
Cabinet Tamper Lockout (tamper location must be specified)	x	x	x	x
VMAS Tamper Lockout			x	
No Contact Limits Lockout	x	x	x	x
Station License Lockout	x	x	x	x
No test authorization in inventory	x	x	x	x
Failure to pay required payment	x	x	x	x
Invalid Software Version	x	x	x	x
VLT Corruption Error	x		x	
DLT Corruption Error		x		x

The RI2000 shall be prohibited from performing the listed inspections for the specified conditions listed below:

Lockout Type	Tests Affected by Lock-Out

	Common	TSI& Safety	Non-Loaded Diesel & Safety	Transient & Safety	Loaded Diesel & Safety
Vortex Strut Lockout			x	x	
Dynamometer calibration required			x	x	x
Dynamometer calibration failure			x	x	x
Raw Oxygen sensor out of calibration	x	x	x	x	
NO response time			x	x	
O2 response time			x	x	
NDIR response time	x	x	x	x	
VMAS flow lockout			x	x	
Fuel cap tester failure	x	x	x	x	
Fuel cap tester out of calibration	x	x	x	x	
Leak check required	x	x	x	x	
Leak check failure	x	x	x	x	
Raw Transport Delay Check			x	x	
No test authorizations in inventory	x	x	x	x	x
No stickers loaded in inventory	x	x	x	x	x
No VIR Paper	x	x	x	x	x
Out of Temperature Window (See Sec 2 – Temperature Operating Range)	x	x	x	x	
Hard disk is full	x	x	x	x	x
Floppy disk or disk mechanism failure	x	x	x	x	x

Sticker Tamper	x	~~xx~~	~~xx~~	~~xx~~	~~x~~

b   *Lockouts Sent to and Received from HCS, H=HCS, A=Analyzer*

Name	Set	Clear
QA/State Lockout	H/A	H/A
Analyzer Hardware Lockout	A	A
Cabinet Tamper Lockout	A	A
VMAS Tamper Lockout	A	A
No Contact Limits Lockout	A	A
Station License Lockout	H	H
Failure to pay required payment	H	H
Invalid Software Version	H	H
VLT Corruption Error	H	H
DLT Corruption Error	H	H

c   *QA/State Lockout*

Set or cleared from either the analyzer keyboard by State authorized persons or through the HCS by persons using the Administrative Application at the HCS. The HCS will honor a lockout set from the keyboard and will set the status as locked.

d   *Cabinet/VMAS Tamper and Analyzer Hardware Lockouts.*

These lockouts are set by the analyzer when components go bad or when a tamper condition is set. Tamper lockouts are cleared by service personnel from the service menus or by QA/State personnel from the QA/State menu. Analyzer Hardware Lockouts should be self-clearing when the condition causing the lockout is corrected. The HCS does not set or clear these tamper/lockouts.

e   *No Contact Limits Lockout.*

These "offline" inspections are stored on the analyzer. When the analyzer establishes communications with the HCS and transmits all of the stored inspections the analyzer unlocks itself.

This lockout is set by the analyzer when the following is exceeded:

Max Window Tests without Contact/ Max Window Days without Contact. This lockout shall be set whenever the running total of XXX inspections

(Max Window Tests without Contact field in N̶E̶T̶W̶O̶R̶K̶CONFIG.DAT file) have been performed by the RI2000̶ within YYY consecutive days (Max Window Days without Contact field in N̶E̶T̶W̶O̶R̶K̶CONFIG.DAT file) without communicating to the HCS.

f   *Station License Lockout*

This lockout is always set and cleared through the HCS.

g   *Insufficient Funds*

This lockout is set and cleared by automatic processes controlled by accounts receivable status of the station. When the account is settled the station is unlocked.

h   *No test authorization in Inventory*

This lockout is set by the analyzer when the total test authorization inventory (one-year inventory + two-year inventory) reaches zero. It is automatically cleared by the analyzer when a batch of test authorizations is sent from the HCS.

i   *Invalid Version: Software*

During the logon process the analyzer reports to the HCS the current software version number and date. If the information is incorrect, the HCS will lockout the analyzer until the analyzer reports the correct version.

Analyzer manufacturer service will be required to correct software version problems.

j   *Corruption Errors*

During the logon process the analyzer reports to the HCS the current version dates and row counts for these tables: VLT and DLT.

Manufacturer field service representatives will be required to correct VLT and DLT problems.

1̶.̶1̶.̶3̶3.3.3   Applicable Model Years & Weight Range

a   *Applicable Model Years*

b   *All vehicles shall be tested, regardless of age. Pass/Fail criteria varies for different model years and is described in the test Pass/Fail section. Emission tests for vehicles older than 25 years do not affect the motorist's ability to receive a passing sticker.*

3.3.4   Applicable Weight Range

3̶.̶3̶.̶4̶Vehicles up to 8500 lbs. can be tested on the RI2000.

3.3.5   Vehicle Information Entry

The full name of each vehicle make must be displayed and printed on the VIR and shall be recorded on the test record. Based on the Network

Responses section, the HCS shall download available vehicle information. Since the HCS does not always have complete information or the RI2000 to HCS communication may have not been successful, the inspector may have to enter some or all of this information manually.

For each inspection the inspector shall always enter at least the odometer reading.

~~1.1.5~~3.3.6 Emission Standards

All emissions standards tables (STD) shall reside in the RI2000 and receive updates from the HCS. The complete table shall be updated, not individual records.

The HCS shall track the updating of the STD tables as sent to each workstation. Upon implementing the new STD table, the old version shall be purged.

The standard tables and the criteria for selecting categories shall be designed in a manner that allows for easy modification or addition. Additional standards categories may be added at a future date.

The STD for the vehicle under test shall be written to the STANDARDS field of the test record.

The following tables will contain standards:

a   TRNSTD

The RI2000 shall use the TRNSTD table and use vehicle input information as search criteria to determine cutpoints.

b   TSISTD

The RI2000 shall look use the TSISTD table and the vehicle input information as search criteria to determine cutpoints for vehicles receiving the Two Speed Idle Test. CO+CO2 dilution limits, MaxIdleSpeed, Avg HC (ppm), Avg CO (CO%) will be found in this file.

c   DSLSTD

The RI2000 shall look use the DSLSTD table and the vehicle input information as search criteria to determine cutpoints for vehicles receiving the loaded diesel and non-loaded diesel tests.

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~~1.1.6~~3.3.7 NO Humidity Correction Factor

The NO humidity correction factor shall be clamped at $K_h = 2.9$.

Corrected NO (grams/mile) = K_h * Uncorrected NO (grams/mile)

Calculate K_h = NO humidity correction factor

$$K_h \cdot e^{[0.004977(H \& 75) \& 0.004447(T \& 75)]}$$

Where:

T = Temperature in F.

H = Absolute humidity in grains of water per pound of dry air.

$$H \cdot \frac{(43.478) \times R_a \times P_d}{P_B \& \left(P_d \times \frac{R_a}{100} \right)}$$

Where:

Ra = Relative humidity of the ambient air, percent.

Pd = Saturated vapor pressure, mm Hg at the ambient dry bulb temperature.

PB = Barometric pressure, mm Hg.

~~1.1.7~~3.3.8 *Dilution Correction Factor* (DCF)

The analyzer system shall calculate the DCF using the following procedure, and shall pre-select the formula appropriate to the vehicle's fuel type. If the calculated DCF exceeds 3.0, a default value of 3.0 shall be used. If the DCF falls below 1.0, then a default value of 1.0 shall be used.

a   Calculate "X" using the analyzer system measurements of CO and CO2.

$$x = \frac{[CO_2]_{meas.}}{[CO_2]_{meas.} + [CO]_{meas.}}$$

Where $[CO_2]_{measured}$ and $[CO]_{measured}$ are the instantaneous emissions test readings.

b   Calculate $[CO_2]_{adjusted}$ using the following formulas.

(1)   For Gasoline:

$$[CO_2]_{adj.} = \left[\frac{x}{4.644 + 1.88x}\right] 100$$

(2)   For Methanol or Ethanol:

$$[CO_2]_{adj.} = \left[\frac{x}{4.73 + 1.88x}\right] 100$$

(3)   For Compressed Natural Gas (CNG):

$$[CO_2]_{adj.} = \left[\frac{x}{6.64 + 1.88x}\right] 100$$

(4)   For Liquid Propane Gas (LPG):

$$[CO_2]_{adj.} = \left[\frac{x}{5.39\% \, 1.88x}\right] 100$$

c)   Calculate the DCF using the following formula.

$$Dilution \; Factor = \frac{|CO_2|_{adj.}}{[CO_2]_{meas.}}$$

1.1.83.3.9 *Engine RPM Detection*

Based on the vehicle identification information entered by the inspector, the RI2000 may assist the inspector in determining which vehicles require a primary pick up, which require that an alternate counting algorithm be used, and which require the use of an auxiliary piece of equipment. Prompts shall be provided to assist the inspector in locating an RPM signal on vehicles equipped with distributorless ignition systems (DIS).

The RPM will be used for TSI tests only. The analyzer shall record the engine RPM simultaneously with the emissions readings. If the RI2000 does not read engine RPM in the proper range, the RI2000 shall prohibit continuation of the inspection until proper RPM range has been achieved. (The manufacturer may propose an error tolerance factor to be used when testing vehicles with unstable RPM.)

For 1996 and newer vehicles, the RI2000, through the OBD-II SAE standardized connector link, shall be capable of providing the tachometer signal.

1.1.93.3.10 *Mass Emission Calculations*

Based on raw concentrations, dilution ratio and dilute flow, the VMAS shall compute the emitted vehicle mass. The following corrections shall be used in the RI2000

a   CO

CO Grams/Mile = Σ[(CO Conc) * Exhaust Volume * CO density]/ ΣDistance

b CO_2

CO_2 Grams/Mile = Σ (CO_2 Conc) * Exhaust Volume * CO_2 density]/ ΣDistance

c   NO

NO Grams/Mile = Σ (NO Conc) * Exhaust Volume * CO density * NO Correction Factor]/ ΣDistance

~~1.1.10~~3.3.11 *Aborted Tests*

All abort events will be recorded in INCOMPLT.DAT, never TEST.DAT.

INCOMPLT.DAT is to be used to track inspections started, aborted and completed by each Inspector on a monthly basis. Each Inspector is to have a record in the file for each month in which that Inspector begins a test on the analyzer. Each counter field shall be handled as follows:

a   TEST STARTED

Increment by 1 following login by the Inspector (create a record for this Inspector at this time if it does not yet exist);

b   TEST ABORTED PRIOR TO EMISSIONS SAMPLING

Increment by 1 when an inspection is exited prior to the emissions sampling test sequence;

c   TESTS ABORTED DURING/AFTER SAMPLING

Increment by 1 when an inspection is exited during or after the emissions sampling test sequence;

d   TESTS COMPLETED

Increment by 1 when a test is completed upon Pass/Fail Determination.

e   INCOMPLT.DAT/INCOMPLT.HST handling

At the beginning of a new month, prior to initial vehicle entry, all records for previous months shall be copied to INCOMPLT.HST. Once the records are copied, they shall be purged from INCOMPLT.DAT; then on the first communication of any month the analyzer must send all records in INCOMPLT.HST to the HCS and purge all records successfully sent.

f   Display Prompt

The inspector should be able to abort the inspection by pressing the "Escape" key. If the inspector presses the "Escape" key, the RI2000 shall display the following message:

DISPLAY PROMPT:

ARE YOU SURE YOU WANT TO ABORT THIS

TEST? (YES/NO)

If the inspector enters Y, then the RI2000 shall abort the inspection.

~~1.4~~3.4 RI2000 Accessory Recognition

3.4.1 Bar Code Scanner

The RI2000 shall detect the presence of the bar code scanner automatically at POWER ON. Bar code format definitions can be found in Appendix VI. The bar code reader at a minimum shall:

- Read VIN from windshield
- Read bar code on audit and calibration gas bottles
- Read RI2000 inspection sticker
- Inspector License

3.4.2 Modem

The modem shall be connected to a fully operational dial-up connection during all times of operation. The modem must be IBM-PC and MS-DOS compatible and show full ASCII file transmission compatibility. The manufacturer must provide all necessary software and protocol for the modem.

~~1.5~~3.5 Inspection Menus

The following menus are required. Rhode Island reserves the right to require modification of any menu if it does not meet the minimum requirements.

~~1.1.1~~3.5.1 *Menus*

The menus shall display the following options:

> **INSPECTION**
>
> **REPAIR MENU**
>
> > RECALL REPAIR RECORDS
> >
> > CREATE NEW REPAIR RECORDS
> >
> > OBTAIN REPAIR STATION LIST
>
> **MANUAL TEST MENU**
>
> > NO-LOAD EMISSIONS MEASUREMENT
> >
> > INSPECTOR SELECTED STEADY LOAD
> >
> > STRUCTURED TEST DRIVE
> >
> > FREE-FORM TEST DRIVE
> >
> > FUEL CAP TEST

CALIBRATION MENU

CALIBRATE ALL

ANALYZER GAS CALIBRATION

ANALYZER SAMPLE SYSTEM LEAK CHECK

DYNAMOMETER CALIBRATION

FUEL CAP TESTER CALIBRATION

FLOPPY DRIVE AND FLOPPY DISK CHECK

OPACITY METER CALIBRATION

VORTEX STRUT CHECK

RAW TRANSPORT TIME CHECK

STATUS PAGE

NETWORK COMMUNICATIONS DIAGNOSTICS MENU

DIAL TONE CHECK

MODEM SERIAL PORT DIAGNOSTICS

NETWORK COMMUNICATIONS DIAGNOSTICS

INSPECTOR TRAINING

RECALL PREVIOUS VEHICLE TESTS & REPRINT VIR

QA/STATE MENU

RI2000 AUDIT SCREEN

UPDATE STATION INFORMATION

VIEW INSPECTOR INFORMATION

INSTALL NEW DATA DISK

LOCKOUT RI2000

PERFORM SOFTWARE UPDATE

SEARCH AND RETRIEVE TEST RECORD

STATE STAFF INSPECTION

COMMUNICATIONS LOG

PERFORM CHALLENGE TEST

WAIVER MENU

WAIVER AUTHORIZATION AND ISSUANCE

RECALL WAIVER HISTORY

~~RECALL REPAIR RECORDS~~RI2000 AUDIT

STATION MANAGER MENU

PURCHASE TEST AUTHORIZATION NUMBERS

REVIEW AUTHORIZATION INVENTORY/ MONTHLY PAYMENT/STICKER STATUS

DATA FILE REFRESH

UPDATE NETWORK COMMUNICATIONS DATA

STATION IDENTIFICATION

SET STATION PASSWORD

LOAD STICKERS

PRINT MONTHLY BILLING STATEMENT REPORT

STATION NEWSLETTER

SERVICE MENU

SERVICE LOGS

UPDATE STATION INFORMATION

UPDATE STATION CONFIGURATION

RAW TRANSPORT TIME DETERMINATION

FLOW AUDIT/CALIBRATION

RAW EXTRACTED VOLUME

RI2000 AUDIT

VIEW INFORMATION MENU

LOCKOUT STATUS

SYSTEM STATUS

VIEW INSPECTOR INFORMATION

STATION INFORMATION

NETWORK COMMUNICATIONS LOG

LOANER UNIT FUNCTIONS

INITIAL CALIBRATIONS

NETWORK COMMUNICATIONS DATA

INSTALL NEW DATA DISK

~~UPDATE VLT~~

~~UPDATE DLT~~

~~UPDATE SDM.DAT~~

~~UPDATE AVGSBS.DAT~~

~~UPDATE AVGCYCLE.DAT~~

RI2000 AUDIT

TURNAWAY DOCUMENTA detailed description of each menu item follows.

~~1.6~~3.6 INSPECTION

The RI2000 shall initiate, run and terminate the I/M inspection sequence in accordance with the following specifications.

All lockout reasons shall be displayed when inspection is selected. Test shall be prevented if ~~lockouts prohibit the Safety test~~any common lockouts are set (see table in RI2000 Lockout Reasons section).

The TECH.DAT file contains all information described in 3.6.1 and 3.6.2. Test Sequence Type in TEST.DAT shall be set to "I" for regular inspections.

~~1.1.1~~3.6.1   *Inspector License Number Entry*

The license number shall be obtained by scanning or manually entering the inspector's badge. It must match a license number stored internally in the RI2000. The number of Test Authorizations remaining (AUTHORIZ.DAT) and Station License and Monthly Payment Expiration dates (CONFIG.DAT) shall be displayed on or prior to the Inspector License Number Entry screen for every test.

DISPLAY PROMPT:

SCAN THE BAR CODE ON YOUR INSPECTOR BADGE OR PRESS --- (function key) **FOR MANUAL ENTRY.**

a   Programming Criteria:

1   If an inspector scans or manually enters a bar-coded inspector license number that is not stored in the Inspector Information Table, the RI2000 shall display the following message:

DISPLAY PROMPT:

THE INSPECTOR LICENSE NUMBER IS NOT IN THE RI2000. CONTACT KEATING.

2   In cases where the badge cannot be successfully scanned, the inspector shall be given the option of manual entry via the following prompt:

DISPLAY PROMPT:

ENTER YOUR INSPECTOR LICENSE NUMBER.

3   After the inspector's license number has been manually entered, the RI2000 shall display the following message:

DISPLAY PROMPT:

YOU USED MANUAL ENTRY. IF YOUR BAR CODE SCANNER IS NOT WORKING, PLEASE GET IT REPAIRED. IF YOU DO NOT HAVE AN INSPECTOR BADGE LICENSE, PLEASE CONTACT KEATING. FREQUENT USE OF MANUAL ENTRY WILL BE INVESTIGATED.

4   Inspector license numbers shall be three alpha characters (CIT (Certified Inspector Technician), CRT (Certified Repair Technician), or CIR (Certified Inspector Repair Technician)) followed by six numeric characters. Only inspectors with CIT or CIR licenses shall be allowed to conduct inspections. If accepted by the RI2000, the inspector license number shall be written to the Test Inspector License Number field of the test record.

5   The HCS shall transmit inspector license numbers, expiration dates, ~~inspection class~~ and training level to the RI2000. The RI2000, upon receiving this information from the HCS, shall read and store this information in the appropriate locations within the Inspector Information Table. Print the inspector's name and license number on the VIR.

6   In the case of bar code entry, the RI2000 shall store a B (bar code scanner) in the Inspector License Input Source field of the test record; otherwise an M shall be stored to indicate manual entry. This field must be populated for every valid test record sent to the HCS.

7   If there are less than 15 days before an inspector's license expires, the RI2000 shall issue a warning to the inspector every time a test is initiated by that inspector.

8   If the inspector's license is expired, the RI2000 shall issue a warning to the inspector, and the test shall be aborted.

9   If the inspector's license is locked out, per the Lockout in TECH.DAT, the RI2000 shall issue a warning to the inspector, and the test shall be aborted.

3.6.2 Inspector Access Code Entry

After entry of the inspector's license number, the RI2000 shall require manual entry of the inspector s access code. The TECH.DAT file is utilized.

DISPLAY PROMPT:

ENTER YOUR INSPECTOR ACCESS CODE.

a   *Programming Criteria:*

1   Do not display actual entries on the screen, use X's.

2   The access code must match the code stored internally in the Inspector Information Table. The RI2000 shall allow three attempts to enter a valid access code. Following each of the first two attempts, the following message shall be displayed.

DISPLAY PROMPT:

INCORRECT ACCESS CODE - TRY AGAIN.

3   After the third unsuccessful attempt, the following message shall be displayed.

DISPLAY PROMPT:

THE ACCESS CODE ENTERED IS INCORRECT. CONTACT KEATING. THE TEST IS ABORTED.

The RI2000 shall return to the Main Menu.

~~1.1.3~~3.6.3 Initial Vehicle Data Entry

The TEST.DAT, NETWORK.DAT, PLATCODE.DAT files are utilized. The following information must be attained, entered, confirmed or reviewed in this sequence:

a) ENTER LICENSE PLATE ISSUING STATE

b) CONFIRM REGISTRATION

c) ENTER LICENSE PLATE TYPE

d) ENTER LICENSE PLATE NUMBER

e) FORMAT LICENSE PLATE NUMBER

~~e)~~f)   ENTER VEHICLE IDENTIFICATION NUMBER (VIN)

~~f)~~g)   AUTHORIZATION INVENTORY (AS DETERMINED BY VIN) FOR TEST TYPE NOT DEPLETED

~~g)~~h)   ENTER INITIAL STICKER NUMBER

~~h)~~i)   REVIEW SCREEN

The following sections shall be displayed on individual screens with the ability to scroll back through the list and make edits prior to initiating communications.

The data shall be written to the appropriate fields of the test record. If a repair record exists for this vehicle, the data shall also be written to the proper fields of the repair record. All of the following information must be entered for an inspection and shall be printed on the VIR:

> VEHICLE IDENTIFICATION NUMBER (VIN)
>
> LICENSE PLATE NUMBER
>
> LICENSE PLATE ISSUING STATE

a   *ENTER LICENSE PLATE ISSUING STATE*

~~A mechanism shall be included for conforming license plate format to the State Registration Database license plate format.~~ ***(Requirements for this mechanism are reserved but shall be defined and implemented prior to startup).***

The RI2000 shall prompt the inspector for the issuing state of the vehicle license plate.

DISPLAY PROMPT:

SELECT THE LICENSE PLATE ISSUING STATE

1   Programming Criteria:

   i   The RI2000 shall display a list containing the names and abbreviations of the 50 states, District of Columbia, Puerto Rico, Guam, American Samoa, Mexico, Canada, Armed Forces Plate, Federal and various locations. A list is provided in Attachment VII.

   ii   The cursor shall default to Rhode Island. However, under no circumstances shall the "Rhode Island" selection be entered into the test record automatically — it must be confirmed by the inspector.

   iii   The inspector shall be allowed (by scrolling through the list) to select the one that applies for the vehicle under test. The RI2000 shall display the following message:

DISPLAY PROMPT:

SELECT AND ENTER THE "ISSUING STATE" OF THE LICENSE PLATE.

iv   The RI2000 shall write the issuing state abbreviation in the *License Plate "Issuing State"* field of the test record. The issuing state field must be populated for every valid test record sent to the HCS. The RI2000 shall print the full name of the issuing state on the VIR.

v   If the *"Issuing State"* is not RI

DISPLAY PROMPT:

ARE YOU SEEKING RI REGISTRATION (Y/N)

Programming Criteria

a)   If YES, reject the vehicle and display

DISPLAY PROMPT:

VEHICLE IS NOT ELIGIBLE FOR INSPECTION.

REGISTRATION IS REQUIRED PRIOR TO INSPECTION.

INSTRUCT THE VEHICLE OWNER TO CONTACT KEATING @ (AAA) – AAA – AAAA FOR MORE INFORMATION.

Note:(AAA) – AAA - AAAA is passed from the HCS in the NETWORK.DAT file

b)   If NO, set the "*Out-of-State Inspection*" field in the TEST.DAT to "Y" and continue the inspection at the Enter License Plate Number prompt.

DISPLAY PROMPT:

AN OUT-OF-STATE INSPECTION WILL BE PERFORMED.

b   *CONFIRM REGISTRATION*

Display the following prompt If the "Issuing State" is RI:

DISPLAY PROMPT:

ENSURE VEHICLE HAS VALID REGISTRATION. ENTER "Y" FOR YES OR "N" FOR NO.

1   Programming Criteria:

i   If 'Y', inspection shall be continued.

ii   If 'N', inspection shall be aborted.

iii   ERROR MESSAGES:

> ### DISPLAY PROMPT:

> **INVALID ENTRY – TRY AGAIN**

c   ENTER RI LICENSE PLATE TYPE

Only if "Rhode Island" is selected as the Issuing State, the RI2000 shall prompt the inspector to enter the license plate type from the registration document.

> ### DISPLAY PROMPT:

> **SELECT THE LICENSE PLATE TYPE THAT APPEARS ON THE REGISTRATION.**

1   Programming Criteria:

i   The RI2000 shall display a list of <u>text descriptions associated with</u> plate type codes contained in the PLATCODE.DAT file passed from the HCS. <u>The default value shall be "Private Passenger." (Plate Code 1 in PLATCODE,DAT)</u> There can be a maximum of 200 plate type codes.

ii   The inspector shall be allowed (by scrolling through the list) to select the one that applies for the vehicle under test. The RI2000 shall display the following message:

> ### DISPLAY PROMPT:

> **SELECT AND ENTER THE "LICENSE PLATE TYPE"**

iii   The RI2000 shall write the License Plate type <u>code associated with the selected text description</u> to the test record. The plate type must be populated for every valid test record with RI as the Issuing State. The RI2000 shall print the license plate type on the VIR.

d   ENTER LICENSE PLATE NUMBER

The RI2000 shall prompt the inspector to manually enter the license plate number.

> ### DISPLAY PROMPT:

ENTER THE LICENSE PLATE NUMBER EXACTLY AS IT APPEARS ON THE REGISTRATION.

Programming Criteria:

i   The license plate number input shall be limited to 10 characters.

ii   If there is no entry, the RI2000 shall display the following message:

DISPLAY PROMPT:

NO VALUE HAS BEEN ENTERED - - TRY AGAIN.

iii   If the length of the plate number is less than the Minimum Plate Length in the PLATCODE.DAT for the plate type code entered (or less than one for vehicles without RI plates), the RI2000 shall:

DISPLAY PROMPT:

AT LEAST <u>X</u> CHARACTERS MUST BE ENTERED FOR THIS PLATE TYPE -- TRY AGAIN

*Note: **X** is the Minimum Plate Length in the PLATCODE.DAT for the plate type code entered, or "1" for vehicles without RI plates.*

iv   If the length of the plate number is greater than the Maximum Plate Length in the PLATCODE.DAT (or greater than ten for vehicles without RI plates)for the plate type code entered, the RI2000 shall:

DISPLAY PROMPT:

NO MORE THAN <u>Y</u> CHARACTERS MUST BE ENTERED FOR THIS PLATE TYPE -- TRY AGAIN

~~e~~Note: Y is the Maximum Plate Length in the PLATCODE.DAT for the plate type code entered, or "10" for vehicles without RI plates.

e   *FORMAT LICENSE PLATE NUMBER*

Once the inspector continues past the license plate number screen, the analyzer shall format the license plate number according to the RI Registration Number Categories formats.

1   If the RI License Plate Type is Dealer (any of codes 23, 24, 32, 34) then the entire plate number is right justified with

leading spaces to set the plate number to the proper length indicated by PLATCODE.DAT. Example of dealer plate with maximum length 6 as stored in 10 character TEST.DAT field: "$_s$123AA$_{ssss}$", where "$_s$" indicates a space.

2   If the RI License Plate Type is Radio Operator (code 18) then the entire plate number is left justified with trailing spaces to set the plate number to the proper length indicated by PLATCODE.DAT. Example of Radio Operator plate with maximum length 6 as stored in 10 character TEST.DAT field: "WA1XY$_{sssss}$", where "$_s$" indicates a space.

3   If the RI License Plate Type is NOT Dealer or Radio Operator, and it is alphanumeric, then the alpha portion is left justified and the numeric portion is right justified. Spaces are added in between set the plate number to the proper length, indicated by PLATCODE.DAT. Example of alphanumeric plate with maximum length 6 as stored in 10 character TEST.DAT field: "AB$_s$123$_{ssss}$", where "$_s$" indicates a space.

4   If the RI License Plate Type is NOT Dealer or Radio Operator, and it is numeric, then the entire plate number is right justified with leading zeroes to set the plate number to the proper length, indicated by PLATCODE.DAT. Example of numeric plate with maximum length 6 as stored in 10 character TEST.DAT field: "000012 $_{ssss}$", where "$_s$" indicates a space.

f   ENTER VEHICLE IDENTIFICATION NUMBER (VIN)

The RI2000 shall prompt the inspector:

DISPLAY PROMPT:

SCAN THE BAR CODE ON THE VEHICLE FOR THE VIN IF IT IS AVAILABLE

OTHERWISE ENTER THE VIN MANUALLY AS IT APPEARS ON THE VEHICLE.

IF THE VIN EXCEEDS 17 CHARACTERS ENTER THE LAST 17 CHARACTERS ONLY.

1   Programming Criteria:

i   The bar code scanner shall be used whenever possible. To help ensure the accuracy of manual entry, the license number must be entered correctly twice (dual entry method). Both entries must match before proceeding with an inspection.

DISPLAY PROMPT:

BOTH ENTRIES ARE NOT THE SAME. TRY AGAIN.

ii   If fewer than 17 characters are entered, the RI2000 shall display the following message:

DISPLAY PROMPT:

THE VIN ENTERED HAS FEWER THAN 17 CHARACTERS. VERIFY THAT THE VIN ENTERED MATCHES THE VEHICLE'S ACTUAL VIN.

iii   The RI2000 shall automatically store the source of the VIN. For VIN Input Source field:

V = Bar code on vehicle

M = Manual entry

This field must be populated in the test record for every valid test record sent to the HCS. The RI2000 shall write the input source in the *VIN Input Source* field of the test record.

iv   If there is no entry, the RI2000 shall display the following message:

DISPLAY PROMPT:

NO VALUE HAS BEEN ENTERED - - TRY AGAIN.

v   The RI2000 shall display the following message if letters "I", "O", or "Q" are entered by the inspector (but these entries shall be allowed):

DISPLAY PROMPT:

VERIFY VIN. VIN SHOULD NOT CONTAIN THE LETTERS I, O, OR Q.

vi   The RI2000 shall not accept symbols.

DISPLAY PROMPT:

INVALID CHARACTER ENTERED - TRY AGAIN.

~~f~~g   *AUTHORIZATION INVENTORY (AS DETERMINED BY VIN) FOR TEST TYPE NOT DEPLETED*

At program start, the biennial inspection requirement is detected by the VIN:

1   Prior to MMDDYYYY (Begin Biennial Inspection field in NETWORK.DAT), all vehicles are eligible for inspection To start the biennial cycle, the following logic shall be applied:

   i   If the last VIN character is an odd digit*:*

   - A TSI or Non-Loaded Diesel test shall be performed

   - The one-year inspection fee is charged (*One Year Test Fee* in NETWORK.DAT)

   - The sticker shall expire 1 year from issue date.

   ii   If the last VIN character is a non-numeric character or an even digit:

   - A transient or Loaded Diesel test shall be performed, depending on the other emission test selection rules;

   - The full inspection fee is charged;

   - The sticker shall expire 2 years from issue date.

2   On or after MMDDYYYY (Begin Biennial Inspection field in NETWORK.DAT), for all vehicles,

   - A transient or Loaded Diesel test shall be performed, depending on the other emission test selection rules;

   - The two-year inspection fee is charged (*Two Year Test Fee* in NETWORK.DAT);

   - The sticker shall expire 2 years from issue date.

Authorization Inventory shall be checked at this point:

Programming Criteria:

i   If a one-year test is determined, the analyzer shall verify that one-year authorization inventory exists.

ii   If a two-year test is determined, the analyzer shall verify that two-year authorization inventory exists.

iii   If the selected inventory is depleted, display the following prompt and abort the test:

DISPLAY PROMPT:

(ONE-YEAR/TWO-YEAR) TEST AUTHORIZATION INVENTORY IS DEPLETED. TEST MAY NOT CONTINUE UNTIL THE NECESSARY TYPE OF INVENTORY HAS BEEN LOADED.

~~gh~~   ENTER STICKER NUMBER

This prompt shall not be displayed until the current date is greater than or equal to the Previous Sticker Prompt Date (MMDDYYYY in NETWORK.DAT).

DISPLAY PROMPT:

SCAN THE BAR CODE ON THE INSPECTION STICKER OR ENTER THE STICKER NUMBER MANUALLY. PRESS (function key) IF NOT AVAILABLE.

1   Programming Criteria:

i   If the inspector scans the STICKER (scanned entries cannot be edited), the RI2000 shall proceed. The RI2000 shall allow manual entry of the sticker number.

ii   The sticker contains a bar code using either code 39 or 128 symbologies. The bar-code scanner must be able to automatically discriminate between the symbologies to ensure that the current information shall be automatically read.

iii   The RI2000 shall automatically store the source of the sticker. For *Sticker number input source* field:

S = Bar code on sticker

M = Manual entry

The RI2000 shall write the input source in the *Initial Sticker number input source* field of the test record.

iv   The input shall allow up to a 9 digit numeric entry. If invalid entry,

DISPLAY PROMPT:

INVALID ENTRY - - TRY AGAIN.

v   The Initial Sticker Number and Initial Crosscheck Validation Code fields shall be written to the TEST.DAT file.

~~hi~~   REVIEW SCREEN

The software shall display a summary of all the entered vehicle information. At this point, the inspector shall be prompted to verify the data and, if necessary, correct any incorrect entries.

DISPLAY PROMPT:

IS THIS DATA CORRECT? (YES/NO)

1   Programming Criteria:

i   If the inspector changes any vehicle data, the software shall automatically begin prompting the inspector, as necessary, to edit the previously entered vehicle data.

ii   All rules outlined in 3.6.3 must be applied if any field is edited.

~~1.1.4~~3.6.4 Communication Specification

(This information is confidential and may only be released by HCS Provider with written consent from KTI.)

~~1.1.5~~3.6.5 RI2000 Initiated Actions

After connecting to the HCS, the RI2000 shall transmit data as indicated by the communication specification.

a   Transmit Initial Vehicle Data

The RI2000 shall display the following message:

DISPLAY PROMPT:

SEARCHING FOR VEHICLE INFORMATION, PLEASE WAIT.

1 Programming Criteria:

  i If ~~No VIN/license plate match or Invalid VIN is~~ HCS Match Found is not set to Y by the HCS, then the RI2000 shall prompt the inspector as follows:

DISPLAY PROMPT:

VEHICLE HAS NOT BEEN FOUND. VERIFY THAT INFORMATION HAS BEEN ENTERED CORRECTLY.

RE-ENTER AND PRESS --------- (function key) TO PROCEED.

  ii The RI2000 shall allow the inspector to completely re-scan or re-enter the information in 3.6.3. If changes are made, the RI2000 shall prompt the inspector to press a function key to initiate a second call to the HCS.

  iii If test data has been transferred from the HCS to the RI2000 unit, the RI2000 shall not allow changes or corrections to data entered in 3.6.3.

  iv During NO COMMUNICATION with the HCS, the RI2000 shall permit testing. Data shall be entered per Vehicle Specific Entry/Verification section.

b Transmit Records

All required records that the RI2000 has created in accordance with the RI2000 Data File Layout section shall be sent to the HCS, as detailed in the communication specification.

DISPLAY PROMPT:

TRANSMITTING DATA, PLEASE WAIT.

1 Programming Criteria:

i The first record of each file transmitted will be the oldest. After successful transmission, each record shall be moved to a history file or deleted, per the RI2000 Data File Layout section.

ii For TEST.DAT, the RI2000 shall retain a minimum of one thousand (1,000) of the most recent records by overwriting the oldest record.

iii If successful communications cannot be achieved (the RI2000 has not communicated with the HCS), then the RI2000 shall display the following message.

DISPLAY PROMPT:

CANNOT ACCESS NETWORK. PROCEED WITH THE INSPECTION.

c *Transmit Test Authorization Purchase Request*

The RI2000 shall transmit test authorizations purchase requests to the HCS. The RI2000 shall allow the Station Manager or Owner through the Station Manager Menu to place a test authorizations purchase order and transmit it to the HCS.

~~1.1.6~~3.6.6 *Network Responses*

HCS and establishes a session, the HCS will respond with stored transactions and data which are waiting for transmission to the RI2000. These messages are:

a) SYSTEM DATE/TIME UPDATE

b) LOCKOUT STATUS

c) INSPECTOR(S) TABLE

d) PURCHASED TEST AUTHORIZATIONS PROCESSED

e) RHODE ISLAND MESSAGES

f) VEHICLE DATA

g) EMISSIONS STANDARDS (TRNSTD, DSLSTD, TSISTD) TABLES

h) STATION NEWSLETTER

i) VLT/DLT UPDATE

j) Station Information Received

k) Default Horsepower Table Update

l) Any additional information as indicated by the communication specification

The automatic transaction and message updates will occur on every session initiated by the RI2000 except during communications diagnostic transactions. The communications interface will provide the RI2000 application with the appropriate status information to determine which transactions have occurred following HCS session initiation.

a   Receive SYSTEM DATE/TIME UPDATE

The current RI2000 date/time settings shall be reset each time contact is made with the HCS (except during network diagnostics or loop back). The HCS shall pass the current date/time settings to the RI2000. Upon receiving the date and time settings, the date and time received shall serve as the date stamp (test date) and time stamp (test start time) for the inspection in progress. The RI2000 shall use the received date and time settings to update the RI2000 clock. (If the RI2000 uses other clocks, the RI2000 shall be required to update the appropriate system clock.) The inspection start date and time stamp for an inspection shall be set in the test record following the receipt of the System Date/Time Update by the RI2000 just after the initial HCS contact. If communication attempts fail for the initial HCS contact, the date and time stamp shall be set using the RI2000 clock . See communication specification for further information.

The test date, test start time and test end time shall be recorded in the test record in the following fields, as appropriate: *Date of Test*, *Test Start Time* and *Test End Time.* Each of these fields must be populated in the test record for every valid test record. Print the test date and test end time on the VIR.

B   RECEIVE LOCKOUT/TAMPER STATUS

The status (on/off) of the lockouts and/or tampers shall be transmitted by the HCS to the RI2000. If a lockout(s)/tamper(s) is set, then the current inspection shall be prohibited until the applicable lockout(s)/tamper(s) has been cleared. The HCS shall return the state of the lockout/tamper conditions to the RI2000, contained in the lockout file.

If a lockout/tamper has been set by the HCS, the RI2000 shall display one or more of the messages shown below:

DISPLAY PROMPT:

THE INSPECTION CANNOT BE PERFORMED DUE TO A QA/STATE INSTALLED LOCKOUT BEING SET. CONTACT LOCAL KEATING OFFICE FOR FURTHER INSTRUCTIONS.

THE INSPECTION CANNOT BE PERFORMED DUE TO A CABINET TAMPER. CALL FOR SERVICE.

THE INSPECTION CANNOT BE PERFORMED DUE TO A VMAS TAMPER. CALL FOR SERVICE.

THE INSPECTION CANNOT BE PERFORMED DUE TO AN HCS CONTACT LIMIT LOCKOUT. CONTACT LOCAL KEATING OFFICE FOR FURTHER INSTRUCTIONS.

THE INSPECTION CANNOT BE PERFORMED DUE TO ISSUES RELATED TO STATION LICENSE. CONTACT LOCAL KEATING OFFICE FOR FURTHER INSTRUCTIONS.

INSUFFICIENT FUNDS. THE INSPECTION CANNOT BE PERFORMED DUE TO A FAILURE TO PAY REQUIRED PAYMENT. CONTACT KEATING HELP DESK FOR FURTHER INSTRUCTIONS.

THE RI2000 SOFTWARE VERSION IS OLD. CALL FOR SERVICE.

THE VLT DATABASE IS CORRUPT. CALL FOR SERVICE.

THE DLT VERSION IS CORRUPT. CALL FOR SERVICE.

c   *RECEIVE INSPECTOR(S) TABLE (TECH.DAT)*

The RI2000 shall receive the entire Inspector Information File for the station (not individual inspector file) from the HCS. The RI2000 software shall not allow changes to the Inspector Information File from the RI2000. Inspector information can only be changed from the HCS. Upon receiving the inspector information from the HCS, the RI2000 software shall not be required to validate the inspector information received from the HCS.

If there is an update, the RI2000 shall display the following message:

DISPLAY PROMPT:

THE INSPECTOR LICENSE NUMBER AND ACCESS CODE TABLE HAS BEEN UPDATED BY THE HCS. THIS TABLE CAN BE VIEWED AND PRINTED FROM THE STATION

**MANAGER'S MENU. PLEASE CHECK AND IF THERE ARE
PROBLEMS, CONTACT KEATING.**

d   *Receive PURCHASED TEST AUTHORIZATIONS NUMBERS*

Authorization numbers, if applicable, shall be transmitted during initial or
end-of-test contacts or data refresh, as entire file, not individual records.
The numbers shall be received in multiples of XX (XX per lot, Number
Authorizations Per Batch Inventory Type 1 and Number Authorizations Per
Batch Inventory Type 2) and shall be stored in the inventory until needed.
There is limit on authorization lots that can be purchased (for a single
transaction) via the RI2000-initiated purchase in the station manager's
menu. Upon receiving the test authorization numbers from the HCS, the
RI2000 software shall not be required to validate the test authorization
numbers received from the HCS.

New test authorization inventory shall be received in a separate file from
refreshed test authorization inventory. Complete specifications shall be
found in the communication specification.

The RI2000 shall display a TEST AUTHORIZATION RECEIVED message
and shall print a receipt, as received in a message from the HCS, per the
example shown below:

ELECTRONIC TEST AUTHORIZATION NUMBER PURCHASE RECEIPT

Date: MM/DD/YYYY   Station: Station License #

Time: HH:MM   RI2000 ID: RI2000 #

Inventory Type: Type #

**Test authorization numbers have been issued to this station via
electronic transfer. If purchase has not been pre-paid, usage of
these test authorization numbers will be revoked immediately if
payment is not received.**

Range of Auth #   Total Auth #. Cost/Auth.   Total Cost   Inventory Type

Note: List each range of (XX) test authorizations.

e   *Receive Rhode Island Messages*

Rhode Island messages shall be transmitted by the HCS to the RI2000
during all communication sessions except during the network diagnostic
routine. Rhode Island messages will be in text file format. All new
messages shall be displayed immediately after the inspector selects
INSPECTION from the main menu. If the message(s) is not displayed due
to power interrupt, aborted test, printer jam, etc., the message(s) shall be
displayed the next time the inspector selects INSPECTION from the main
menu. It is the responsibility of the RI2000 unit to verify that all Rhode

Island messages received are displayed AND given the option to print. The RI2000 shall display these messages one-time-only and shall provide an option to print. All displayed messages shall default to print and the inspector must press a function key to continue.

Prior to displaying a Rhode Island message(s), the RI2000 shall display the following prompt:

DISPLAY PROMPT:

RHODE ISLAND MESSAGES HAVE BEEN RECEIVED. THE MESSAGE WILL ONLY BE DISPLAYED ONCE. MA RECOMMENDS THAT THE MESSAGE BE PRINTED FOR FUTURE REFERENCE.

F   RECEIVE VEHICLE DATA

The following vehicle data in the proper test record format, if available, shall be sent from the HCS to the RI2000. The RI2000 shall allow this data set to be verified (if applicable) and confirmed/changed by the inspector on a vehicle data review screen. If any of the data marked by "*" is changed, the "Data from HCS Modified" field in TEST.DAT shall be set to "Y".

- Vehicle Model year*
- Vehicle type
- GVWR*
- Vehicle make
- Vehicle model name
- Number of cylinders
- Engine size (displacement) (in liters)
- Transmission type
- Previous Emission Test Selection*
- Fuel type*
- Body Type
- Engine make
- Engine year
- Diesel Exhaust Diameter
- Diesel Turbo
- HP@RPM
- VLT Row ID Number
- **Previous odometer reading (See Note 1)

- **Previous failed test results (if applicable)
- **Date of failed test (if applicable)
- Test Counter

Note 1. Do not display.

Asterisk (**) can never be modified by inspector.

GENERAL NOTE: The following vehicle data shall be entered during each Inspection by the inspector, as applicable:

- Current Odometer Reading
- Exhaust Configuration

Descriptions on handling of specific data items follow:

1   RECIEVERECEIVE PREVIOUS FAILED TEST DATA FOR RETEST

Failed vehicle test results from the previous inspection (in accordance with the test record), shall be sent from the HCS to the RI2000 and shall be displayed to the inspector. The RI2000 shall display the following test result information relative to a vehicle that has failed a previous Inspection on the screen, and shall provide an option to print.

- Date of Previous Test   mmddyyyy

  Visual Inspection Result   Pass/Fail/NA

- TSI Test Result   Pass/Fail/NA
- Transient Test Result   Pass/Fail/NA
- Functional Test Result   Pass/Fail/NA
- Safety Overall Result   Pass/Fail/NA
- Diesel Test Result   Pass/Fail/NA

Exactly what failed within the following testing sequences shall be displayed:

  Visual Inspection Result   Pass/Fail/NA

- Functional Test Result   Pass/Fail/NA
- Safety Overall Result   Pass/Fail/NA

The previous passed components will be recorded as passed in the current test record. Only the primary result indicators need to be stored (Transient Test Result, Diesel Test Result, TSI Test Result, Visual Inspection Result, Functional Test Result, and Safety Overall Result). Fields secondary to the

result fields do not need to be sent from the HCS or stored in the new test record.

The previous failed components will be sent by the HCS. Components to be sent are:

- Transient Test P/F Result

- Diesel Test P/F Result

- TSI Test P/F Result

- ~~Visual Inspection P/F Result (and all secondary visual inspection results)~~

- Functional Test P/F Result (and all secondary functional inspection results)

- Safety Overall P/F Result (and all secondary safety inspection results)

Each previously failed section shall be redone in its entirety except the Functional Test. The individual, manually-entered ~~Visual,~~ Functional, and Safety items shall be populated with the previous entries; changes are allowed to all items, both Pass to Fail and Fail to Pass, etc. The only exception is the Functional Fuel Cap Test. If the Functional Fuel Cap Test passed in the previous inspection but another functional component, i.e., MIL, failed, all Functional Test components should be available for re-entry, except the Functional Fuel Cap Test shall not be redone.

2   RECEIVE VLT ROW ID NUMBER

A VLT Row ID Number for the vehicle under test shall be sent from the HCS to the RI2000 for use during the inspection. The number is stored in the *VLT Row ID Number* field of the test record and shall be printed on the VIR. If there is no previous test record, or no VLT Row ID Number is received, the RI2000 shall search the RI2000 resident VLT).

3   RECEIVE PREVIOUS EMISSION TEST SELECTION

The Previous Emission Test Selection field will be sent down from the HCS in the test record. In the case of a retest, the HCS shall set the Previous Emission Test Selection according to the Final Emission Test Selection from the previous test record. The Previous Emission Test Selection field shall not be modified. Any changes made to parameters that affect the Emission Test Selection/Dynamometer Testability criteria shall cause these rules to be reapplied to determine Emission Test Selection required. If the test is not a retest, HCS

Emission Test Selection will be '0' or blanks sent by the HCS, indicating that the analyzer rules must be applied to determine Emission Test Selection required.

4   RECEIVE PREVIOUS ODOMETER READING

The odometer reading for a vehicle's previous inspection will be sent to the RI2000 from the HCS in the proper test record format and shall follow the display prompt routine and programming criteria set forth in Vehicle Specific Data Entry/Verification, Vehicle Odometer Reading section. The previous odometer reading shall not be displayed.

5   RECEIVE TEST COUNTER

Process response, apply information as required in the Vehicle Specific Data Entry/Verification and Test Payment & Authorization sections.

6   RECEIVE HCS Match Found

"HCS Match Found" flag is received in test record from HCS. Process response per RI2000 Initiated Actions Section.

7   RECEIVE Previous Test OBD-II Readiness Result

Process response per the OBD-II section.

8   RECEIVE Emission Repair Time Delay Waiver Previously Issued

Process responses per the print sticker section.

g   *RECEIVE EMISSIONS STANDARDS (STD) TABLES*

The RI2000 shall receive STD Table updates. The RI2000 shall receive the entire STD Tables (not individual categories) if applicable, from the HCS.

h   *STATION NEWSLETTER*
Process response per Intranet Messaging Functions section.

i   *VLT UPDATE*
Process response per Vehicle Look-Up Table (VLT) section.

j   *Station Information Received*

The HCS shall pass the PE Mode, ~~VMS Mode,~~DMV Headquarters Facility, Monthly Payment Expires, ~~and~~ Station License Expires, Max No Contact Days Window, Max No Contact Tests Window, and Block Island Station information per the communication specification to be stored by the RI2000 in CONFIG.DAT.

k   *Default Horsepower Table Update*

The RI2000 shall receive DFLTHP Table updates. The RI2000 shall receive the entire DFLTHP Table, if applicable, from the HCS.

l   *Any additional information as indicated by the communication specification*

Process responses per the communication specification.

1.1.73.6.7   *Vehicle Specific Data Entry/Verification*

For all inspections, the following vehicle-specific data entry is required: odometer.

Manual entry of all other vehicle specific data is required when the data is not received from the HCS or the VLT.   Even when the VLT Row ID is passed from the HCS, the RI2000 shall utilize the VLT Parametric Variables.

Vehicle specific data entry or verification is required for items listed below.

- Vehicle Model Year
- Vehicle Type
- Vehicle Make
- Vehicle Model Name
- Body Type
- Gross Vehicle Weight Rating (GVWR)
- Number of Cylinders
- Vehicle Engine Size
- Transmission Type
- Vehicle Odometer Reading
- Exhaust Configuration
- Vehicle Fuel Type Code
- Engine make
- Engine year
- Exhaust Pipe Diameter
- Turbo
- HP@RPM

The following sequence and rules shall be followed:

a   *Off-line Testing: Special Features*

1   Precedence

If there is no HCS communication or there is no vehicle data passed from the HCS, the RI2000 shall query the test record files stored in the RI2000. The following order of precedence is followed when referring to vehicle data retrieval:

i   HCS

ii   RI2000 Test Records

iii   Manual Entry/VLT

2   Test Counter

The Test Counter field will be sent down from the HCS in the test record. In the case of a retest, the HCS shall set the Test Counter to the value that it had in the previous test record, and the current Test Counter = Test Counter (from HCS test record) + 1.   If the Test Counter is not available from the HCS, a previous test record for this vehicle is stored on the RI2000, and the most recent test performed on this vehicle failed, the Test Counter = Test Counter (from previous analyzer test record) + 1. If the Test Counter is not available from the HCS, and either there are no test records for this vehicle stored on the RI2000 or the most recent test performed on this vehicle did not fail, then Test Counter = 1. The Test Counter shall be written to the TEST.DAT. If the test counter is even (2, 4, 6, …) and the previous test was performed at the same station within the last 30 days (<= 30 days ago), the retest is free.

3   Check for Previous Emission Repair Time Delay Waiver

DISPLAY PROMPT:

DID PREVIOUS STICKER INDICATE EMISSION REPAIR TIME DELAY WAIVER? ENTER 'YES' IF THERE IS A PREVIOUS STICKER AVAILABLE, AND THE STICKER CONTAINS THE CODE 'PTW'. OTHERWISE, ENTER 'NO'.

i   Program Criteria

"Y" or "N" shall be stored in the Previous Emission Repair Time Delay Waiver field in TEST.DAT.

b   Vehicle Model Year

DISPLAY PROMPT:

ENTER THE MODEL YEAR.

1   Programming Criteria:

~~iVehicle model years older than XXXX (where XXXX is Model Year Exempt field in the NETWORK.DAT will not require an emission test.~~

~~ii~~i_____Requires four-character model year entry. Four-digit model year shall be recorded in the *Vehicle Model Year* field of the test record and printed on the VIR.

~~iii~~ii_____Minimum entry is 1900; maximum entry is current year + 1.

~~iv~~iii_____ERROR MESSAGES:

DISPLAY PROMPT:

NO VALUE HAS BEEN ENTERED - TRY AGAIN

MODEL YEAR IS NOT VALID - TRY AGAIN

c   Vehicle Type

DISPLAY PROMPT:

ENTER THE VEHICLE TYPE:

SELECT THE APPROPRIATE VEHICLE TYPE FROM THE LIST BELOW:

CODE	VEHICLE TYPE
P	**PASSENGER CAR**
T	**TRUCK**
M	**MOTORHOME/BUS**

Programming Criteria:

1.   The software shall be designed so that only P, T, or M can be entered for this field and if incorrect based on other vehicle data, an error message will be displayed:

ERROR MESSAGE:

VEHICLE TYPE IS NOT VALID - TRY AGAIN

2.   The actual vehicle type (P, T, or M) shall be written to the *Vehicle Type* field of the test record. Print the vehicle type on the VIR.

d   Vehicle Fuel Type Code

Corrections to the transient emissions for fuel type shall be passed from the HCS in the NETWORK.DAT table.

DISPLAY PROMPT:

ENTER THE VEHICLE FUEL TYPE CODE:

SELECT THE APPROPRIATE FUEL TYPE CODE FROM THE LIST BELOW (ELECTRIC AND HYDROGEN VEHICLES ARE NOT TESTED ON THIS ANALYZER).

CODE	FUEL TYPE
G	**GASOLINE**
P	**LIQUID PROPANE GAS (LPG)**
N	**NATURAL GAS (CNG)**
M	**METHANOL (greater than 20%)**
L	**ETHANOL (greater than 20%)**
D	**Diesel**
O	**Other**

1   Programming Criteria:

    i   Entry of one of the above codes is required. The software shall be designed so that only a G, P, N, M, L, D, or O can be entered by the inspector for this prompt. The software shall default to gasoline.

    ii   Entries shall be written to the *Fuel Type 1* field of the test record. Print the fuel type on the VIR.

    iii   ERROR MESSAGES:

DISPLAY PROMPT:

NO VALUE HAS BEEN ENTERED - TRY AGAIN

INVALID ENTRY - TRY AGAIN

    iv   For TSI tests, the RI2000 shall apply the dilution correction factor for the fuel type selected and shall provide a function key to switch the DCF on/off. (*This programming criterion only applies to manual testing mode.*)

    v   For transient test, the RI2000 shall apply the fuel mass correction factor for the fuel type entered, contained in

the NETWORK.DAT.

vi   Based on fuel entry, the RI2000 shall use the proper look-up table. If the fuel is "D", the Diesel VLT (DLT shall be used). Otherwise, the VLT shall be used.

vii   Once fuel entry is complete, the following prompt shall be displayed:

DISPLAY PROMPT:

IF THE VEHICLE IS BI-FUELED, ENTER "Y" FOR YES OR "N" FOR NO.

viii   If the inspector selects "N" for No, then the *Fuel Type 2* field in TEST.DAT shall be left blank.

ix   If the inspector selects "Y" for Yes, then the following prompt shall be displayed:

DISPLAY PROMPT:

ENTER THE SECOND VEHICLE FUEL TYPE CODE:

SELECT THE APPROPRIATE FUEL TYPE CODE FROM THE LIST BELOW (ELECTRIC AND HYDROGEN VEHICLES ARE NOT TESTED ON THIS ANALYZER).

CODE   **FUEL TYPE**

G   **GASOLINE**

P   **LIQUID PROPANE GAS (LPG)**

N   **NATURAL GAS (CNG)**

M   **METHANOL (greater than 20%)**

L   **ETHANOL (greater than 20%)**

D   **Diesel**

O   **Other**

2   Programming Criteria:

i   Entry of one of the above codes is required. The software shall be designed so that only a G, P, N, M, L, D, or O can be entered by the inspector for this

prompt. The software shall default to gasoline.

ii   Entries shall be written to the *Fuel Type* 2 field of the test record. Print the fuel type on the VIR.

iii   ERROR MESSAGES:

DISPLAY PROMPT:

NO VALUE HAS BEEN ENTERED - TRY AGAIN

INVALID ENTRY - TRY AGAIN

BOTH DUAL FUEL TYPES CANNOT BE THE SAME FUEL TYPE - TRY AGAIN

iv   For TSI tests, the RI2000 shall apply the dilution correction factor for the fuel type selected and shall provide a function key to switch the DCF on/off. (*This programming criterion only applies to manual testing mode.*)

v   For transient test, the RI2000 shall apply the fuel mass correction factor for the fuel type entered, contained in the NETWORK.DAT.

vi   Based on fuel entry, the RI2000 shall use the proper look-up table. If the fuel is "D", the Diesel VLT (DLT shall be used). Otherwise, the VLT shall be used.

vii   If dual fuels are entered, and one is gasoline, Fuel Code "G" shall take precedence when searching the VLT.

Fuel type(s) shall be printed on the VIR.

e   Vehicle Make

1   Programming Criteria:

i   Display prompt for passenger cars and light-~~,~~ and medium ~~- and heavy~~-duty trucks:

DISPLAY PROMPT:

ENTER THE VEHICLE MAKE:

SELECT THE APPROPRIATE MAKE FROM THE LIST. IF THE MAKE IS NOT LISTED, TYPE IN THE FULL NAME OF THE MANUFACTURER. IF IT IS A KIT CAR OR SPECIALLY-CONSTRUCTED VEHICLE, ENTER "SPCN."

ii   If the vehicle type is P or T, display all discrete vehicle makes found for the vehicle's model year in the *Make* field of the appropriate lookup table. "Not Listed" and "SPCN" should be added to the end of the list as a selection, or as a separate function available on the screen. If "Not Listed" is selected, the following prompt shall be given:

**DISPLAY PROMPT
FOR P or T:**

ENTER THE NAME OF THE MANUFACTURER AS SHOWN ON THE REGISTRATION OR TYPE IN THE FULL NAME. (THE ENGINE MAKE AND YEAR WILL BE ENTERED LATER.)

iii   If the vehicle type is an M, the inspector shall be advised to enter the name of the manufacturer from the displayed list.

**DISPLAY PROMPT
FOR MOTORHOMES:**

ENTER THE NAME OF THE MANUFACTURER AS SHOWN ON THE REGISTRATION OR TYPE IN THE FULL NAME. (THE ENGINE MAKE AND YEAR WILL BE ENTERED LATER.)

iv   All vehicle make names shall be entered by a method (approved by Rhode Island) which maximizes user friendliness, preferably via direct cursor selection or the first few letters of the name. For example, the inspector should be able to enter the first letter of the vehicle make which would cause the cursor to go to the first make on the list which would also be highlighted. If that is the correct make, the ENTER key would be pressed. If it is not the correct make, the inspector would at least be close and only have to move the cursor a short distance to the right one.

v   The full name shall be displayed and printed on the VIR and stored on the test record.

f   Vehicle Model Name

DISPLAY PROMPT:

SELECT OR ENTER VEHICLE MODEL NAME

1   Programming Criteria:

i   If the vehicle type is P or T, display all discrete vehicle models found for the vehicle's make and model year in the Public*ModelName* field of the appropriate lookup table. "Not Listed" should be added to the end of the list as a selection, or as a separate function available on the screen. If "Not Listed" is selected, the following prompt shall be given:

DISPLAY PROMPT:

ENTER THE NAME OF THE MODEL AS SHOWN ON THE REGISTRATION OR TYPE IN THE FULL NAME. (THE ENGINE MAKE AND YEAR WILL BE ENTERED LATER.)

ii   If the vehicle type is M, or the make is SPCN, the software shall skip the "Model" entry, and leave the field in the test record blank.

iii   The full model name shall be printed on the VIR and displayed on the screen; up to 23 characters shall be provided on the test record in the *Vehicle Model Name* field for vehicle model.

g   VLT/DLT SEARCH

The software shall refer to the RI2000-resident VLT/DLT to select the appropriate test weight and load values for vehicles with GVWR $\leq$ 8,500. To access the VLT/DLT, the software shall search for a match based on the vehicle year, make, model, and fuel type (fuel type is needed for VLT only).

1   Programming Criteria:

i   If a match is found based on year, make and model, the RI2000 shall display all possible vehicle configurations in a user-friendly manner. The inspector shall select the configuration that best matches the vehicle to be tested. The Rhode Island proposed display will include the VLT/DLT query inputs at the top of the screen:

MODEL YEAR

MAKE (DIVISION)

MODEL

FUEL TYPE

If dual fuels are entered, and one is gasoline, Fuel Code "G" shall take precedence when searching the VLT. If dual fuels are entered, and neither is gasoline, Fuel Type 1 shall take precedence when searching the VLT.

The display is expected to contain the following information for each resultant listing, one vehicle configuration per line:

BODY TYPE

NUMBER OF CYLINDERS

ENGINE SIZE (DISPLACEMENT)

TRANSMISSION TYPE

ii   If the operator determines that none of the listings match the vehicle being tested, the RI2000 shall prompt the inspector to enter the following information: body type, number of cylinders, engine size, and transmission type.

h   *Gross Vehicle Weight Rating*

The inspector shall be required to enter the GVWR if it is not available in the VLT. If the GVWR is available to the VLT, the RI2000 shall allow the operator to edit the value.

DISPLAY PROMPT:

ENTER THE GROSS VEHICLE WEIGHT RATING (GVWR) IN LBS; IF GVWR IS NOT AVAILABLE, ENTER " NOT AVAILABLE "

1   Programming Criteria:

i   If the inspector enters NOT AVAILABLE and the VEHICLE TYPE = PASSENGER CAR, the analyzer shall automatically enter 5999 for GVWR.

ii   If the inspector enters NOT AVAILABLE and the VEHICLE TYPE = MOTORHOME, the analyzer shall automatically enter 8500 for GVWR.

iii   If the inspector enters NOT AVAILABLE and the VEHICLE TYPE = T the analyzer shall display:

DISPLAY PROMPT:

IF THE VEHICLE IS A SMALL SIZE TRUCK, MINI-VAN, SPORT UTILITY OR IS CERTIFIED AS LIGHT-DUTY OR RATED AS A ½ TON (FOR EXAMPLE: GM 10 OR 1500 SERIES, DODGE 100 OR 1500 SERIES, OR FORD 100 OR 150 SERIES), ENTER 5999 FOR GVWR.

IF THE VEHICLE IS A MEDIUM-DUTY TRUCK OR FULL SIZE VAN OR IS CERTIFIED AS A MEDIUM-DUTY OR RATED AS A 3/4 TON (FOR EXAMPLE: GM 20 OR 25 SERIES OR FORD 250 SERIES), ENTER 8499 FOR GVWR.

iv   ERROR MESSAGES:

DISPLAY PROMPT:

NO VALUE HAS BEEN ENTERED - TRY AGAIN

TOO MANY CHARACTERS HAVE BEEN ENTERED - TRY AGAIN

GVWR MUST BE AT LEAST 2000 LBS – TRY AGAIN

    v   The GVWR must be printed on the VIR and recorded in the GVWR field of the test record.

    vi   The GVWR source (M = Manual Entry, L = VLT, ~~V~~H = HCS) will be written to the TEST.DAT file.

  i   *Body Type*

DISPLAY PROMPT:

ENTER THE VEHICLE BODY TYPE:

SELECT THE APPROPRIATE VEHICLE BODY TYPE FROM THE LIST BELOW:

CODE   VEHICLE BODY TYPE

1   SEDAN

2   STATION WAGON

3   PICKUP

4   SPORT/UTILITY VEHICLE

5   MINIVAN

6   FULL-SIZE VAN/MOTOR HOME/BUS

1   Programming Criteria:

i   The RI2000 shall present a pick list of the vehicle body types to assist the Inspector in selecting the body type appropriate for the vehicle under test. The RI2000 shall store the selected body type in the *Body Type* field of the test record.

ii   For Motorhomes/Buses, the "Body type" entry in the pick list will be the same as for Full Size Van.

j   Number of Cylinders

DISPLAY PROMPT:

ENTER THE NUMBER OF CYLINDERS; FOR ROTARY ENGINES, ENTER AN "R."

1   Programming Criteria:

i   Valid entries for cylinders are 3, 4, 5, 6, 8, 10, and 12. Any entries outside of these will be rejected by the system, except that for Rotary engines, the inspector shall be prompted to enter an R and the software shall store R in the *Number of Cylinders* field of the test record. Print the number of cylinders on the VIR.

ii   ERROR MESSAGES:

DISPLAY PROMPT:

NO VALUE HAS BEEN ENTERED - TRY AGAIN

NUMBER OF CYLINDERS ENTERED IS NOT VALID - TRY AGAIN.

k   Vehicle Engine Size

DISPLAY PROMPT:

ENTER THE VEHICLE ENGINE SIZE:

ENTER THE ENGINE SIZE FOLLOWED BY ONE OF THE

FOLLOWING CODES.

CODE DESCRIPTION

I CUBIC INCHES

L LITERS

C CUBIC CENTIMETERS

1   Programming Criteria:

i   The first five bytes shall be the engine size. The last byte shall be the unit used for the engine size, and shall be L for liters, I for cubic inches, or C for cubic centimeters. The software shall be designed so that only an I, L or C can be entered for the units. Liter size entries shall be in the format of XX.X. Although the internal storage on the test record in the *Engine Displacement* field is to be automatically converted to liters, the display shall remain in the original units entered. Print the engine size in liters on the VIR.

To convert from cubic inches to liters, multiply by .016387. To convert from cubic centimeters to liters, divide by 1000. Products shall be rounded to the nearest 0.1L. For example, 1550 cubic centimeters shall be 1.6L; 1549 cubic centimeters shall be rounded down to 1.5L.

ii   An error message shall be displayed if the inspector enters an equivalent engine size greater than 17.0L or smaller than 0.5L. The inspector shall be instructed to correct the entry or abort the test. If the vehicle under test is not in the VLT and the engine size entered by the inspector is greater than 10.7L, the RI2000 shall display the prompt:

DISPLAY PROMPT:

ENGINE SIZE IS GREATER THAN 10.7 LITERS. ARE YOU SURE THIS IS CORRECT? (YES/NO)

iii   If yes, the RI2000 shall accept the entry and continue with the test. If no, the RI2000 shall revert to the Enter Engine Size screen.

iv   The software shall make a validity check on the engine size entered by the inspector for the particular year,

make and model of vehicle being inspected. If the engine size is not found in the VLT, the inspector shall be prompted to verify that the correct size was entered. The inspector shall be allowed to change the entry or to continue after confirming that the entry is correct.

    v   ERROR MESSAGES:

DISPLAY PROMPT:

NO VALUE HAS BEEN ENTERED - TRY AGAIN

ENGINE SIZE OR ENTRY IS NOT VALID FOR THIS YEAR, MAKE AND MODEL OF VEHICLE - TRY AGAIN.

l   Transmission Type

DISPLAY PROMPT:

INDICATE THE TYPE OF TRANSMISSION:

    ENTER "M" FOR MANUAL

    ENTER "A" FOR AUTOMATIC

    1   Programming Criteria:

        i   Record in the *Transmission Type* field of the test record. Print the transmission type on the VIR.

        ii   ERROR MESSAGES:

DISPLAY PROMPT:

NO VALUE HAS BEEN ENTERED - TRY AGAIN

m   Exhaust Stack or Pipe Diameter

DISPLAY PROMPT:

ENTER THE EXHAUST STACK OR PIPE DIAMETER SIZE IN INCHES.

    1   Programming Criteria:

        i   Record in the *Diesel Exhaust Diameter* field of the test record.

        ii   Numerical input 5 characters long with the following format (XX.XX).

        iii   Input required for diesel fuel type only.

iv   ERROR MESSAGES:

DISPLAY PROMPT:

NO VALUE HAS BEEN ENTERED - TRY AGAIN

n   Turbo

DISPLAY PROMPT:

IS THE VEHICLE TURBOCHARGED?

ENTER "Y" FOR YES

ENTER "N" FOR NO

1   Programming Criteria:

i   ERROR MESSAGES:

DISPLAY PROMPT:

NO VALUE HAS BEEN ENTERED - TRY AGAIN

ii   Record in the *Diesel Turbo* field of the test record.

iii   Input required for diesel fuel type only.

o   Engine Make

DISPLAY PROMPT:

ENTER THE Engine Make.

1   Programming Criteria:

i   Record in the *Engine Make* field of the test record.

ii   Provide for text input 15 characters long.

iii   Input required for diesel fuel type, SPCN and Motorhomes only.

iv   ERROR MESSAGES:

DISPLAY PROMPT:

NO VALUE HAS BEEN ENTERED - TRY AGAIN

p   Engine Year

DISPLAY PROMPT:

ENTER THE Engine Year.

1   Programming Criteria:

        i   Record in the *Engine Year* field of the test record.

        ii   Provide for numeric input 4 characters long.

        iii   Input required for diesel fuel type, SPCN and Motorhomes only.

        iv   Minimum entry is 1900; maximum entry is current year + 1.

        v   ERROR MESSAGES:

DISPLAY PROMPT:

NO VALUE HAS BEEN ENTERED - TRY AGAIN

q   *HP@RPM*

DISPLAY PROMPT:

ENTER THE RATED ENGINE HORSEPOWER @ RPM.

1   Programming Criteria:

        i   Record in the HP@RPM field of the test record.

        ii   Numerical input 8 characters long with the following format (XXX@XXXX). The @ symbol shall be automatically placed by the RI2000.

        iii   Input required for diesel fuel type only.

        iv   ERROR MESSAGES:

DISPLAY PROMPT:

NO VALUE HAS BEEN ENTERED - TRY AGAIN

r   *Vehicle Odometer Reading*

DISPLAY PROMPT:

ENTER THE VEHICLE ODOMETER READING EXACTLY AS SHOWN.

DO NOT MAKE ADJUSTMENTS FOR ODOMETER ROLL-OVER.

A MINIMUM OF ONE NUMERIC ENTRY IS REQUIRED. DO

NOT ENTER THE TENTH'S DIGIT.

IF NO ODOMETER READING, ENTER 0.

1 Programming Criteria:

    i   If the odometer reading is less than the previous odometer reading received from the HCS, display the following prompt:

DISPLAY PROMPT:

PLEASE VERIFY THE ODOMETER READING.

IS THE ODOMETER READING CORRECT? (YES/NO)

IF NO, ENTER THE CORRECT ODOMETER READING.

    ii   The analyzer shall only accept an entry of all numbers or 0 in the odometer field. If the inspector enters 0, the RI2000 shall translate this to 000000 for the *Odometer Reading* field of the test record, display 000000 and print 000000 on the VIR.

    iii   If the inspector enters an odometer reading higher than 99,000 miles for a vehicle five or less model years old, the following prompt shall be displayed:

DISPLAY PROMPT:

MILEAGE ENTERED IS HIGH FOR THE YEAR OF THE VEHICLE. CHECK THE MILEAGE AND RE-ENTER IF INCORRECT. DO NOT ENTER 1/10ths OF MILES.

        The inspector shall be allowed to re-enter the mileage or use a function key to continue if the reading is correct. The analyzer shall accept the second entry.

    iv   If the inspector enters an odometer reading of less than 100,000 miles and the vehicle is 15 or more model years old, the following prompt shall be displayed:

DISPLAY PROMPT:

MILEAGE ENTERED IS LOW FOR THE AGE OF THE VEHICLE. CHECK THE MILEAGE AND RE-ENTER IF INCORRECT.

        The inspector shall be allowed to re-enter the mileage

or use a function key to continue. The analyzer shall accept the second entry.

        v   ERROR MESSAGES:

DISPLAY PROMPT:

NO VALUE HAS BEEN ENTERED - TRY AGAIN

ODOMETER READING IS NOT VALID - TRY AGAIN

s   Exhaust Configuration

DISPLAY PROMPT:

DOES THE VEHICLE HAVE DUAL EXHAUST? (YES/NO)

1   Programming Criteria:

        i   Record in the *Dual Exhaust* field of the test record.

        ii   ERROR MESSAGES:

DISPLAY PROMPT:

INVALID ENTRY – TRY AGAIN

~~1.1.8~~3.6.8 Review Screen

If HCS Match Found is "Y", any changes made to the HCS data shall cause the RI2000 to prompt the following:

DISPLAY PROMPT:

YOU~~R~~ ARE CHANGING DATA PASSED FROM THE RI DATABASE --- PLEASE RE-VERIFY

The software shall display a summary of all the entered vehicle information. At this point, the inspector shall be prompted to verify the data and, if necessary, correct any incorrect entries.

DISPLAY PROMPT:

IS THIS DATA CORRECT? (YES/NO)

1   Programming Criteria:

        i   The RI2000 shall not allow changes or corrections to data entered in 3.6.3. If any such changes or corrections must be made the test shall be aborted.

ii   If HCS Match Found is "Y", and any data from the HCS is changed, the RI2000 shall display the following prompt:

DISPLAY PROMPT:

YOUR ARE CHANGING DATA PASSED FROM THE RI DATABASE --- PLEASE RE-VERIFY

iii   If the inspector changes any vehicle data, the software shall automatically begin prompting the inspector, as necessary, to repeat the vehicle data entry process.

iv   If HCS Match Found is "Y", and any data from HCS which is marked by an asterisk (*) in the Receive Vehicle Data section is modified, the *Data From HCS Modified* field of the TEST.DAT shall be sent to "Y". If not, the Data From HCS Modified field shall be set to "N".

3.6.9 Emission Test Selection

Emission Test Selection

Selection	Code
TSI	2
Transient	3
Non-Loaded Diesel	4
Loaded Diesel	5

The Previous Emission Test Selection field will be sent down from the HCS in the test record. In the case of a retest, the HCS shall set the Previous Emission Test Selection according to the Final Emission Test Selection from the previous test record. The Previous Emission Test Selection field shall not be modified. Any changes made to parameters that affect the Emission Test Selection/Dynamometer Testability criteria shall cause these rules to be reapplied to determine Emission Test Selection required. If the test is not a retest, HCS Emission Test Selection will be '0' or blanks sent by the HCS, indicating that the analyzer rules need to be applied to determine Emission Test Selection required.

Note that until the diesel program is implemented, vehicles having fuel type = D (diesel) will receive a 1-year sticker and one-year sticker fee. The tailpipe test is exempt – overall pass is determined by safety result only. Current and Final Emission Test Selection fields shall be set to 4.

a   Fuel Type Rule

Vehicles having fuel type G, P, N, M, or L are eligible for a transient test, depending on the other emission test selection rules.

Vehicles having fuel type D are eligible for either a non-loaded or a loaded diesel test, depending on dynamometer testability.

Vehicles having fuel type O shall receive a TSI test.

b   Model Year Rule

If the Current Year minus the Model Year is greater than 25 years, the operator shall be given the choice to do a TSI or a Transient test. The emission test P/F result shall NOT affect the overall P/F result.

c   Program Startup VIN/Year Rule

At program start, the biennial inspection requirement is detected by the VIN.

1   Prior to MMDDYYYY (Begin Biennial Inspection field in NETWORK.DAT), all vehicles are eligible for inspection To start the biennial cycle, the following logic shall be applied:

i   If the last VIN character is an odd digit*:*

- A TSI or Non-Loaded Diesel test shall be performed

- The one-year inspection fee is charged (*One Year Test Fee* in NETWORK.DAT)

- The sticker shall expire 1 year from issue date.

ii   If the last VIN character is a non-numeric character or an even digit:

- A transient or Loaded Diesel test shall be performed, depending on the other emission test selection rules;

- The full inspection fee is charged;

- The sticker shall expire 2 years from issue date.

2   On or after MMDDYYYY (Begin Biennial Inspection field in NETWORK.DAT), for all vehicles,

- A transient or Loaded Diesel test shall be performed, depending on the other emission test selection rules;

- The two-year inspection fee is charged (*Two Year Test Fee* in NETWORK.DAT);

- The sticker shall expire 2 years from issue date.

3.6.10 Dynamometer Testability:

a   If the station is a Block Island station (Block Island Station = Y in CONFIG.DAT), the analyzer shall select TSI or non-loaded diesel, and display the following prompt:

DISPLAY PROMPT 1:

BLOCK ISLAND STATION INDICATED.

PROCEED WITH NON-LOADED TEST.

ab   If "Two Wheel Drive Dyno Testing Possible" from VLT is set to "N", the analyzer shall select TSI or non-loaded diesel, and display the following prompt:

DISPLAY PROMPT 32:

VEHICLE LOOKUP TABLE INDICATES THAT THE VEHICLE CANNOT BE TESTED ON A TWO-WHEEL DRIVE DYNAMOMETER.

PROCEED WITH NON-LOADED TEST.

bc   if "Two Wheel Drive Dyno Testing Possible" from VLT is NOT set to "N", the RI2000 shall prompt the operator as follows:

DISPLAY PROMPT 3:

CAN THE VEHICLE BE TESTED ON A TWO-WHEEL DRIVE DYNAMOMETER? (YES/NO)

WARNING: IT IS THE INSPECTOR'S RESPONSIBILITY TO DETERMINE 4WD/AWD APPLICABILITY.

     i   If yes, the Final Emission Test Selection set by the RI2000 shall be a dynamometer test.

     ii   If no, the software shall select TSI or non-loaded diesel, and display the following prompt:

DISPLAY PROMPT 4:

SELECT THE REASON WHY THE VEHICLE CAN NOT BE TESTED ON THE DYNAMOMETER.

     A.   **ALL-WHEEL-DRIVE OR FULL-TIME FOUR-WHEEL-**

DRIVE WITHOUT TRACTION CONTROL

    B.   **ALL-WHEEL-DRIVE OR FULL-TIME FOUR-WHEEL-DRIVE WITH TRACTION CONTROL**

    C.   **NON-DISENGAGEABLE TRACTION CONTROL**

    D.   **VEHICLE IS HANDICAP EQUIPPED.**
        Programming Criteria:

    iii   The software shall require the selection of one item before proceeding.

    iv   The software shall store the appropriate letter (A, B, C, or D) to the *Dyno Non-Testable Reason* field of the test record.

    v   A TSI or Non-Loaded Diesel test shall be performed.

    vi   If *Dyno Non-Testable Reason* is D, display the following prompt:

DISPLAY PROMPT 5:

VEHICLE IS HANDICAP EQUIPPED. MOTORIST SHALL REMAIN IN VEHICLE AND PERFORM NON-LOADED TEST.

    vii   The Final Emission Test Selection shall be set according to the actual test selected.

3.6.11 Safety Inspection

A safety test shall be performed on all vehicles. The SAFETY.DAT file is utilized. There will be a maximum of 50 unique safety tests, of which a maximum of 25 can be performed in an inspection.

    a   *Safety Test Configurations*

The SAFETY.DAT file contains the information needed to determine what types of safety tests are performed. The complete SAFETY.DAT file will be provided to the RI2000 manufacturer for use in program software. The types of test to be performed will be based on:

    1   Fuel Type (diesel/non-diesel)

In addition, the SAFETY.DAT file will contain the following information:

    1   Safety Test Name – This field shall contain the name of each safety test item.

    2   Safety Test Help Content – This field shall contain the specific requirements from the RI regulations and any additional help information.

3   Dynamometer Test Prevention – If the Transient Test Prevention field of the SAFETY.DAT file contains a "Y", a transient test shall not be performed on the vehicle if that component fails the inspection. For example, if the "Tires" of the safety test fails and there is a "Y" in the Transient Test Prevention field, the transient or loaded diesel tests shall not be performed until the vehicle achieves passing results for those components.

4   Display Sequence Number–The display sequence of the safety inspection will be determined by the order of the records in SAFETY.DAT. The records will be ordered by the Display Sequence field. The first Display Sequence number will be "1".

5   Storage Location Offset–The result for each safety test item will be mapped to the Safety Tests field (TEST.DAT) by the Storage Location Offset field (SAFETY.DAT) for each safety test item.   The first Storage Location Offset will be "0". Even if the Display Sequence of a particular safety item changes, the Storage Location Offset will never change. For example, "Brakes" may be second in the display sequence (indicated by Display Sequence = 2), but first in the storage sequence (indicated by Storage Location Offset = 0). In this case, if the Safety Tests field starts at offset 200 in TEST.DAT, the result for the "Brakes" safety item will be stored at offset 200 in TEST.DAT.

6   N/A Not Allowed – Apply per programming criteria below.

b   Safety Test Prompts

The RI2000 shall determine what safety test names apply to the vehicle being tested based on the criteria mentioned above. The applicable safety inspections shall be performed in the sequence indicated in the Safety Test Sequence field.

DISPLAY PROMPT:

(Safety Test Name)

Result	Keyboard Entry	Remote Button
Pass	**P**	**#1**
Fail	**F**	**#2**
Not Applicable	**N**	**#3**

1   Programming Criteria

     i   Data entry may be performed by the wireless remote control or the keyboard. The inputs for all safety tests shall be "P" for pass, "F" for fail or "N" for not applicable for each item.

     ii   If any line item is marked "F" "fail" then set Safety test to fail.

     iii   There shall be no default values when performing the safety P/F/N entries.

     iv   The RI2000 shall allow the inspector to go back to previous entries and make changes.

     v   The Safety Test Help Content field shall be displayed containing the specific requirements from the RI regulations and any additional help information when the inspector hits the help function key*.*

     vi   If a particular safety test in the SAFETY.DAT is not required for the vehicle under test, the TEST.DAT file shall contain an "X" = Not Required.

     vii   If the SAFETY.DAT file contains "Y" in the "N/A Not Allowed: field of the SAFETY.DAT, the N/A option shall not be allowed as an entry.

c   *Display of Final Safety Inspection Test Results*

The software shall display a summary of all the entered safety information. At this point, the inspector shall be prompted to verify the data and, if necessary, correct any incorrect entries.

The RI2000 shall display the final safety inspection test results. As a minimum, the words PASS, FAIL, or N/A shall be written beside each inspection result.

d   *If Final Emission Test Selection is 3 or 5 and the vehicle failed a Dynamometer Test Prevention component of the safety test, the RI2000 shall prevent an emission test. Prevented Dyno Test should be set to "Y" in the test record. The vehicle shall fail the inspection – Overall Result should be set to fail, and the test shall continue at the Repairs Performed Before Test prompt. The reason for prevention of the emission test shall be printed on the VIR. Display Prompt:*

DISPLAY PROMPT:

VEHICLE REQUIRES SAFETY REPAIRS BEFORE TESTING ON THE DYNAMOMETER.

Go to Repair Performed Before Test section.

e   *If no emission test will be performed then go to Repair Performed Before Test section.*

~~1.1.12~~3.6.12 *Sample System*

For vehicles requiring a Transient or TSI idle test, the following procedure will be performed:

a   *Zeroing Analyzer*

The analyzer shall be zeroed in accordance with a) Automatic Zero and b) Zero Drift Lockout Threshold in the Analyzer Requirements section.

b   *HC Hang-up Check*

The HC hang-up check will be done immediately after the analyzer is zeroed and the ambient air is sampled. The zeroing is initiated after an INSPECTION has been initiated and the initial HCS contact sequence has been successfully or unsuccessfully completed. The whole zero-ambient air-HC hang-up sequence runs in background while the inspector is entering vehicle information. If the hang-up check is not completed before the inspector is ready to start the tailpipe test, the RI2000 shall display the following message:

DISPLAY PROMPT:

HC HANG-UP CHECK IN PROGRESS.

If the hang-up check is not successfully completed in 150 seconds from the start of the hang-up check, the RI2000 shall display the following message:

DISPLAY PROMPT:

POSSIBLE DIRTY PROBE, HOSE OR FILTER.

The software shall not allow the inspection to continue before the system passes the HC hang-up check.

~~1.1.13~~3.6.13 *Functional Checks*

(Note: OBD-II requirements for RI2000 will be deferred to 6 months after start of program).

The functional checks will be performed only on gasoline vehicles receiving an emission test (transient or two-speed idle).

The OBD-II tests contained in the Functional Checks section shall be performed for vehicles having model year >= OBD II Model Year (NETWORK.DAT).

The terms "Gas Cap" and "Fuel Cap" are interchangeable in the RI2000.

General notes: The software shall prompt the inspector to perform the indicated functional inspection and enter P, F or N results. If all of the fields in the Functional Check Results portion of the test record (MIL, Fuel Cap, and OBDII, except for the *Fuel Cap Provided* field) contain either a P or N, then P will be entered in *Functional Test Result* field of the test record. If any of these fields contain an F, then F will be entered into *Functional Test Result* field of the test record. The results will be printed on the VIR. If a functional check is not required for any item, the software shall automatically populate the field with an "N" indicating that a function check of the item was not applicable.

Additional notes: OBDII results shall not affect the Functional Test Result unless Official Result Based on OBD is set in NETWORK.DAT. MIL results shall not affect the Functional Test Result unless Official Result Based on MIL is set in NETWORK.DAT.

a   *Visual Fuel Cap Test*

The analyzer shall prompt as follows:

DISPLAY PROMPT:

WAS THE FUEL CAP REPLACED BEFORE THE TEST? (Y OR N)

1   Programming Criteria:

i   Record the fuel cap replaced value in the Fuel Cap Provided field of the test record.

ii   Visual Fuel Cap Test: For all vehicles with fuel type codes G, there shall be a two-part test. The first part shall be a visual inspection checking for the presence of the cap and the second part shall be a functional test. Display the following prompt:

DISPLAY PROMPT:

INSPECT FUEL CAP(S) FOR PROPER FIT AND INSTALLATION. ENTER INSPECTION RESULT:

P = PASS
F = FAIL
S = MISSING

iii   If P, record a P in the Fuel Cap Visual field of the test record and proceed with functional inspection, if applicable.

iv   If F or S, the vehicle fails the visual portion of the Fuel Cap Integrity Test and should automatically fail the functional portion of the test. The F or S shall be recorded in the Fuel Cap Visual Test field of the test record and on the VIR. The functional test shall not be performed.

v   In addition, if the visual test result was F, an F (Fail) shall be recorded in the Fuel Cap Functional field of the test record and on the VIR; if the visual test result was S, a F (Fail) shall be recorded in the Fuel Cap Functional field of the test record and on the VIR.

b   *Functional Fuel Cap Test*

1   Programming Criteria:

i   Functional Fuel Cap Test: For all vehicles with fuel type code G (either *Fuel Type 1* or *Fuel Type 2* in TEST.DAT), there shall be a two-part test. The first part shall be a visual inspection checking for the presence of the cap and the second part shall be a functional test. Display the following prompt:

DISPLAY PROMPT:

PRESS (FUNCTION KEY) TO BEGIN GASOLINE FUEL CAP LEAK DOWN TEST.   IF NO ADAPTER HAS BEEN MANUFACTURED FOR THE VEHICLE BEING TESTED, ENTER AN "A" FOR "NO ADAPTERS AVAILABLE."

ii   If A is entered, the data will be recorded on the VIR and in Fuel Cap Functional field of TEST.DAT. Entering an "A" will complete the fuel cap functional test.

iii   Note that an "A" entry will not cause the vehicle to fail the Fuel Cap Leak-down Test.

iv   If a pass is sent, the data will be recorded on the VIR and the Fuel Cap Functional field of TEST.DAT. After every pass or fail result for the functional fuel cap test, the software shall prompt the inspector as follows:

DISPLAY PROMPT:

IS THERE ANOTHER GASOLINE FUEL CAP TO BE FUNCTIONALLY TESTED? (Y OR N)

v   If Y, repeat the functional test prompts provided above

until an N response if given.

vi   If a fail is sent to the RI2000, the RI2000 shall display the following prompt.

DISPLAY PROMPT:

THE GASOLINE FUEL CAP HAS FAILED. REMOVE THE GASOLINE FUEL CAP AND INSPECT.

TIGHTLY INSTALL THE GASOLINE FUEL CAP ON THE FUEL CAP TESTER AND PRESS (FUNCTION KEY) TO BEGIN FUEL CAP LEAK-DOWN CHECK OR PRESS (function key) TO FAIL THE FUEL CAP.

vii   If the functional test has indicated a failure again, the data shall be recorded in the Fuel Cap Functional field of TEST.DAT.

c   *OBD-I Test*

Malfunction Indicator Light (MIL)/Check Engine Light :

Neither the MIL nor OBD P/F results described below shall affect the overall pass/fail results of the vehicle unless indicated by the HCS (Official Result based on OBD and Official Result based on MIL fields of the NETWORK.DAT). All results however shall appear on the VIR. If the HCS indicates that P/F results described below shall not effect the overall pass/fail results, "Advisory" shall be printed on the VIR, next to the results.

1   Programming Criteria:

i   The inspector shall be prompted to perform the MIL/Check Engine Light functional test and to enter the results of the test. Acceptable responses are "P" for Pass, "F" for Fail or "N" for non-applicable.

DISPLAY PROMPT:

PERFORM THE MIL/CHECK ENGINE LIGHT FUNCTIONAL TEST.

ENTER RESULTS OF MIL/CHECK ENGINE LIGHT FUNCTIONAL TEST (P, F, OR N)

ii   P, N or F shall be recorded in the FunctMIL field of the test record. If the light is on or not working, the vehicle fails this test.

d   *OBD-II Test*

(Note: OBD-II requirements for RI2000 will be deferred until 6 months after the start of the program).

Based on the OBD II Model Year field in the NETWORK.DAT file, the RI2000 shall prompt the inspector to inspect the vehicle's on-board diagnostic system as follows:

    1   MIL Illumination Test – Key-On, Engine Off

DISPLAY PROMPT:

DETERMINE IF THE INSTRUMENT PANEL MALFUNCTION INDICATOR LIGHT (MIL) ILLUMINATES WHEN THE IGNITION KEY IS TURNED TO THE "KEY ON, ENGINE OFF" POSITION.

DOES THE MIL ILLUMINATE WHEN KEY IS PLACED IN "KEY ON, ENGINE OFF" POSITION? (Y OR N)

          i   Help message for this screen shall contain the following text:

"The Malfunction Indicator Light (MIL) is the official term for the warning light that is illuminated by the vehicle's OBD system when a malfunction occurs. Depending on the vehicle make, the MIL will either display "Service Engine Soon," "Check Engine," the international engine symbol along with the word "Check," or some combination of these. The MIL must come on when the ignition key is turned to the "key on, engine off" position. This is to allow inspectors to check that the MIL is capable of illuminating if a malfunction were to occur. On most vehicles, the MIL will stay illuminated as long as the key is in the position. However, on some vehicles, the MIL will illuminate very briefly when the key is turned to the "key on, engine off" position and then will go out. "

          ii   Vehicle fails if MIL does not come on when key is placed in "key on, engine off " position.

          iii   Record results in TEST.DAT – "**OBDII MIL Check (KOEO)**"

    2   MIL Illumination Test – Engine Running

DISPLAY PROMPT:

START THE ENGINE AND ALLOW IT TO IDLE. DETERMINE IF THE MIL IS ILLUMINATED WHILE THE ENGINE IS RUNNING.

DOES THE MIL ILLUMINATE WHEN ENGINE IS RUNNING? (Y OR N)

    i   If the MIL is on while the engine is running, the vehicle's OBD system has determined that there is a problem with the vehicle.

    ii   Vehicle fails if MIL is on while engine is running.

    iii   Record results in TEST.DAT – "**OBDII MIL Illumination**"

DISPLAY PROMPT:

SHUT OFF THE ENGINE.

3   OBDII Hookup

    i   The RI2000 must be equipped with a standard SAE J1978 OBD connector and communications link to allow an RPM signal, readiness codes, fault codes, and Malfunction Indicator Light (MIL) status to be downloaded from the on-board computer for applicable vehicles.

    ii   The equipment design and operation must meet all Federal requirements (contained in 40 CFR 85.2207-2231) and recommended SAE practices (J1962, J1978 and J 1979) for OBDII system inspections.

    iii   The OBDII interrogation process shall be fully integrated into the RI2000. It must be automated and require no inspector intervention to collect and record OBD data retrieved via the OBD diagnostic link. OBDII readiness codes, failure codes, and MIL status shall be automatically retrieved through a standard interface and vehicle connector. No hand-held unit or separate interface may be used.

    iv   If the OBD II Port has previously been connected for the RPM signal, proceed to OBDII Readiness Evaluation Section.

v   If it has not, display the following message:

DISPLAY PROMPT:

**LOCATE THE OBD II DIAGNOSTIC LINK CONNECTOR
AND ATTACH THE VEHICLE CONNECTOR TO THE RI2000
OBD II PORT.**

vi   The RI2000 will prompt for an OBD II diagnostic link
connection (DLC) for all vehicles model year and
newer of the vehicle model year identified in the
NETWORK.DAT OBDII Model Year field. The default
model year must be 1996.

The RI2000 will be designed to provide assistance to
the Inspector with OBD II connector locations using
the VLT.DAT table.

vii   Error Messages:

DISPLAY PROMPT:

**THE OBD II CONNECTION CANNOT BE CONFIRMED -
PLEASE TRY AGAIN.
PRESS <ENTER> TO CONTINUE.**

**IF THE OBD II CONNECTOR IS MISSING, DAMAGED,
TAMPERED OR CANNOT BE LOCATED PRESS
<FUNCTION KEY> TO CONTINUE.**

viii   The RI2000 must allow the Inspector unlimited
attempts to gain a confirmed OBDII connection.

ix   If the Inspector enters the appropriate function key
indicating a missing, damaged, tampered or
inaccessible connector, and the test date is less than
the date in the OBDII Failure Date field in
NETWORK.DAT:

Write 'C' to the OBDII Test Result field in TEST.DAT.
'FAIL' will be printed in the OBD section of the VIR. A
second page will be printed for the VIR indicating that
the vehicle's on-board diagnostic system could not be
checked due to a missing, damaged, tampered, or
inaccessible connector, and the OBD failure is
advisory only.

The failure of the OBD portion of the test WILL NOT result in an overall test failure.

The RI2000 will prompt the Inspector to proceed to the next portion of the test.

x   If the Inspector enters the appropriate function key indicating a missing, damaged, tampered or inaccessible connector, and the test date is equal to or greater than the date in the OBDII Failure Date field in NETWORK.DAT:

Write 'C' to the OBDII Test Result field in TEST.DAT. Write 'F' to the Overall Test Result field in TEST.DAT. 'FAIL' will be printed on the OBD portion and the OVERALL TEST RESULT section of the VIR. A second page will be printed for the VIR indicating that the vehicle's on-board diagnostic system could not be checked due to a missing, damaged, tampered, or inaccessible connector.

The RI2000 will proceed to **Final Results and Printing of VIR**, and no tailpipe emissions inspection will be conducted.

4   OBDII Readiness Evaluation

i   A Mode $01, PID $01 request (in accordance with SAE J1979) shall be transmitted to the on-board computer to determine the evaluation status of the OBD system, the number of emission-related trouble codes stored in memory, and the Malfunction Indicator Light (MIL) status.

ii   If no response is received from the on-board computer to the Mode $01, PID $01 request, and the test date is less than the date in the OBDII Failure Date field in NETWORK.DAT:

Write 'N' to the OBDII Test Result field in TEST.DAT. 'FAIL' will be printed in the OBD section of the VIR. A second page will be printed for the VIR indicating that the vehicle's on-board diagnostic system did not respond to the request for data, and the OBD failure is advisory only. The failure of the OBD portion of the test WILL NOT result in an overall test failure.

The RI2000 will prompt the Inspector to proceed to

the next portion of the test.

iii   If no response is received from the on-board computer to the Mode $01, PID $01 request, and the test date is equal to or greater than the date in the OBDII Failure Date field in NETWORK.DAT:

Write 'N' to the OBDII Test Result field in TEST.DAT. Write 'F' to the Overall Test Result field in TEST.DAT. FAIL will be printed on both the OBD portion and the OVERALL TEST RESULT section of the VIR. A second page will be printed for the VIR indicating that the vehicle's on-board diagnostic system did not respond to the request for data.

The RI2000 will proceed to **Final Results and Printing of VIR**, and no tailpipe emissions inspection will be conducted.

iv   Based on the returned data, the RI2000 shall determine which on-board monitors are supported by the OBD system and the readiness code status of the applicable monitors. Possible monitors include the following:

- Misfire (continuous)
- Fuel system (continuous)
- Comprehensive component (continuous)
- Catalyst (once/trip)
- Heated catalyst (once/trip)
- Evaporative system (once/trip)
- Secondary air system (once/trip)
- Air conditioning system (once/trip)
- Oxygen sensor (once/trip)
- Oxygen sensor heater (once/trip)
- EGR system (once/trip)

v   Continuous monitors are those in which the applicable system/condition is checked continuously during vehicle operation; once/trip monitors are only checked when the vehicle is driven in a certain manner (i.e., over a predefined driving cycle expected to occur in customer service). According to Federal regulation (40 CFR 86.099-17), a vehicle manufacturer is not required to store a readiness code for the continuous operating monitors; however, some may choose to do so.

vi   Possible readiness code responses include: completed, not completed, and not supported/enabled. A response that a monitor is not supported or enabled means that, for this particular vehicle, that monitor is not applicable. Hence, when a 'not supported/enabled' response is given, the RI2000 will not fail the vehicle for that code.

vii   All readiness code values will be written to the appropriate test record fields in TEST.DAT for each inspection using the following format:

- Not supported/enabled = 0

- Completed = 1

- Not completed = 2.

viii   If the value specified in NETWORK.DAT for a particular readiness monitor is "Y", that code shall be used for the overall readiness determination. If the value specified for a readiness monitor in NETWORK.DAT is "N", that code shall be ignored by the RI2000 and not used for the overall readiness determination.

ix   If all readiness monitors applicable to the vehicle being tested that have a value of "Y" specified in NETWORK.DAT do not have the appropriate readiness codes set (i.e., a value of "0" or "1" is not returned via the OBD link from the vehicle on-board diagnostic system), the RI2000 will check the NETWORK.DAT OBDII Failure Date field.

x   If the test date is less than the date in the OBDII Failure Date field:

        Write 'F' to the OBD Readiness Result field in TEST.DAT. 'FAIL' will be printed in the OBD section of the VIR. The failure of the OBDII Readiness portion of the test WILL NOT result in an overall test failure. A second page will be printed for the VIR listing the "unset" readiness codes with an appropriate label of the code associated with the failure. It must also include a message recommending that the motorist contact the appropriate vehicle dealership for assistance in determining the vehicle operating condition that must be accomplished to set the readiness code(s).

The RI2000 will prompt the Inspector to proceed to the next portion of the test.

xi   If the test date is equal to or greater than the date in the OBDII Failure Date field, and if 2 or less monitors are not ready and the previous test readiness status is READY (as determined by the HCS), then:

Write 'N' (not ready) to the OBDII Readiness Result. A second page will be printed for the VIR listing the "unset" readiness code(s) with an appropriate label of the code associated with the failure. Also on the VIR, the RI2000 will print a message recommending that the motorist contact the appropriate vehicle dealership for assistance in determining the vehicle operating condition that must be accomplished in order to set the readiness code(s).

The RI2000 will prompt the Inspector to proceed to the next portion of the test.

xii   If the test date is equal to or greater than the date in the OBDII Failure Date field, and if 2 or less monitors are not ready and the previous test OBD-II readiness result is fail (as determined by the HCS), then:

Write 'F' to the OBDII Readiness Result, OBDII Test Result and Overall Test Result fields in TEST.DAT. 'FAIL' will be printed in the OBD section of the VIR. 'FAIL' will be printed in the OVERALL TEST RESULT section of the VIR. A second page will be printed for the VIR listing the "unset" readiness code(s) with an appropriate label of the code associated with the failure. Also on the VIR, the RI2000 will print a message recommending that the motorist contact the appropriate vehicle dealership for assistance in determining the vehicle operating condition that must be accomplished in order to set the readiness code(s).

The RI2000 will proceed to **Final Results and Printing of VIR**, and no tailpipe emissions inspection will be conducted.

xiii   If the test date is equal to or greater than the date in the OBDII Failure Date field, and if more than 2 monitors are not ready, then:

Write 'F' to the OBDII Readiness Result, OBDII Test Result and Overall Test Result fields in TEST.DAT. A 'FAIL' will be printed in the OBD section of the VIR. 'FAIL' will be printed in the OVERALL TEST RESULT section of the VIR. A second page will be printed for the VIR listing the "unset" readiness code(s) with an appropriate label of the code associated with the failure. Also on the VIR, the RI2000 will print a message recommending that the motorist contact the appropriate vehicle dealership for assistance in determining the vehicle operating condition that must be accomplished in order to set the readiness code(s).

The RI2000 will proceed to **Final Results and Printing of VIR**, and no tailpipe emissions inspection will be conducted.

xiv   If all readiness monitors applicable to the vehicle being tested that have a value of "Y" specified in NETWORK.DAT have the appropriate readiness codes set (i.e., a value of "0" or "1" is returned via the OBD link from the vehicle on-board diagnostic system):

The RI2000 system will proceed to the following section. (Malfunction Indicator Light (MIL) status and Diagnostic Trouble Code (DTC) Check).

5   Malfunction Indicator Light (MIL) status and Diagnostic Trouble Code (DTC) Check

The RI2000 will evaluate the MIL status based on the data returned via the OBD link from the vehicle on-board diagnostic system. The Yes/No (Y/N) status of whether the MIL has been commanded to be illuminated will be recorded in the OBDII MIL Status field of TEST.DAT.

If the MIL is on and/or commanded on, the RI2000 shall send a Mode $03 request to the on-board computer to determine the stored emissions-related powertrain trouble codes. The RI2000 will repeat this cycle until the number of codes reported equals the number expected based on the previous Mode $01 response. Any codes listed in 40 CFR 85.2207(d) shall be recorded on the test record and printed on the second page of the VIR.

i   If the MIL is not commanded on or the vehicle passes

the MIL light check:

Write 'P' to both the OBDII Fault Code Result and OBDII Test Result fields in TEST.DAT. PASS will be printed in the OBD section of the VIR.

The RI2000 will prompt the Inspector to proceed to the next portion of the test.

ii   If the MIL is commanded on or the vehicle fails the MIL light check, the RI2000 will check the TEST.DAT OBDII Failure Date field. If the test date is less than the date in the OBDII Failure Date field:

Write 'F' to the OBDII Fault Code Result and the OBDII Test Result fields in TEST.DAT. The DTC(s) that was found will be written to the Fault Codes field in TEST.DAT. 'FAIL' will be printed in the OBD section of the VIR. The failure of the OBDII portion of the test will NOT result in an overall test failure. A second page will be printed for the VIR listing the DTCs with an appropriate label of the code associated with the failure.

The RI2000 will prompt the Inspector to proceed to the next portion of the test.

If the test date is equal to or greater than the date in the OBDII Failure Date field, the RI2000 will check the OBDII Model Year Retest field in NETWORK.DAT.

iii   If the MIL is commanded on or the vehicle fails the MIL light check, the RI2000 will check the TEST.DAT OBDII Failure Date field. If the test date is equal to or greater than the date in the OBDII Failure Date field, the RI2000 will check the OBDII Model Year Retest field in NETWORK.DAT. If the model year of the vehicle is newer than the model year specified in the OBDII Model Year Retest field:

Write 'F' to the OBDII Fault Code Result, the OBDII Test Result and the Overall Test Result fields in TEST.DAT. The DTC(s) that was found will be written to the Fault Code field in TEST.DAT. 'FAIL' will be printed in the OBD section of the on the VIR. 'FAIL will be printed in the OVERALL TEST RESULT section of the VIR. A second page will be printed for the VIR

listing the DTCs with an appropriate label of the code associated with the failure.

The RI2000 will proceed to **Final Results and Printing of VIR** (sections 3.6.28 and 3.6.29), no tailpipe emissions inspection will be conducted.

iv   If the MIL is commanded on or the vehicle fails the MIL light check, the RI2000 will check the TEST.DAT OBDII Failure Date field. If the test date is equal to or greater than the date in the OBDII Failure Date field, the RI2000 will check the OBDII Model Year Retest field in NETWORK.DAT. If the model year of the vehicle is equal to or older than the model year specified in the OBDII Model Year Retest field in NETWORK.DAT:

Write 'F' to both the OBDII Fault Code Result and OBDII Test Result fields in TEST.DAT. The DTC(s) that was found will be written to the Fault Codes field in TEST.DAT. A 'FAIL' will be printed in the OBD section of the VIR. The failure of the OBDII portion of the test will NOT result in an overall test failure. A second page will be printed for the VIR listing the DTCs with an appropriate label of the code associated with the failure.

The RI2000 will proceed to the tailpipe portion of the test. If the vehicle subsequently passes the tailpipe emissions inspection, the following message will also be printed on the second page of the VIR below the listed DTCs:

"ALTHOUGH THE ABOVE FAULT CODES WERE RETRIEVED FROM THE ON-BOARD DIAGNOSTIC SYSTEM, VEHICLE EMISSIONS ARE STILL WITHIN ACCEPTABLE RANGES. TO ENSURE THAT THE VEHICLE CONTINUES TO OPERATE EFFICIENTLY, IT IS RECOMMENDED THAT THE DEFECTS RESULTING IN THE ABOVE FAULT CODES BE REPAIRED AS SOON AS POSSIBLE."

3.6.14 Testing Preparation

a   *General Procedure for all transient sequences (including diesel)*

1   Safety Checks:

The software shall prompt the inspector to perform any equipment manufacturer-required safety checks. The RI2000 shall display an option to abort the test at this point if the vehicle does not pass the equipment manufacturer-required safety checks, as indicated by the inspector.

2   Dynamometer Test Preparation:

DISPLAY PROMPT:

PERFORM A (TRANSIENT OR LOADED DIESEL) TEST. BE SURE TO DISABLE THE TRACTION CONTROL IF NECESSARY. PRESS (function key) **TO CONTINUE.**

Programming Criteria:

i.   The RI2000 shall require the inspector to press a function key to continue.

ii. The RI2000 shall perform a transient inspection.

3   Restrain the Vehicle:

DISPLAY PROMPT:

IS THE VEHICLE A FRONT-WHEEL DRIVE? (YES/NO)

Programming Criteria:

i   If "Yes" (the vehicle is a front-wheel drive vehicle), the software shall:

Prompt the driver to laterally stabilize, restrain and chock the vehicle on the dynamometer if it has not already been done.

DISPLAY PROMPT:

FRONT-WHEEL DRIVE VEHICLE: LATERALLY STABILIZE, RESTRAIN AND CHOCK.

Testing shall not begin until the vehicle is restrained. Any restraint system shall not impose a vertical force on the drive wheels sufficient to bias exhaust emissions results.

The system shall prompt the operator:

DISPLAY PROMPT:

VERIFY THAT THE RESTRAINTS ARE ENGAGED PRIOR

TO PROCEEDING TO THE NEXT STEP.

> Note: Provisions must be made to ensure that restraints which control side-to-side movement are used on all front-wheel drive vehicles and that the vehicles are not just tied to some fixed object. If the restraint system does not control forward to backward movement, the RI2000 must prompt the inspector to place wheel chocks or equivalent.

ii   If "No" (the vehicle is a rear-wheel drive vehicle), prompt the driver to restrain the vehicle.

DISPLAY PROMPT:

REAR-WHEEL DRIVE VEHICLE: RESTRAIN

4   Dynamometer Settings.

Dynamometer power absorption and inertia weight settings shall be automatically chosen from the VLT. The VLT will contain default dynamometer power absorption and inertia weight settings.

5   Cooling Fan

The analyzer shall prompt the inspector to turn on the fan and to place it in position if the ambient temperature is above 50°F. (The RI2000 may provide the option of automatically turning on the fan from a remote location.)

6   Dilute O2 Stabilization and Ambient Value

The system shall purge with ambient air for a period no shorter than 60 seconds for the O2 sensors to stabilize prior to ambient calibration or exhaust cone hook-up. The system shall automatically detect the presence of a vehicle when performing the O2 stabilization and calibration.

Prior to each test, an ambient collection will be performed with the dilute O2 analyzer for at least 8 seconds and averaged. Blower will be activated prior to ambient collection, and an adequate O2 stabilization period will be allotted. The ambient reading shall be within 20.3 to 21.3%. If the reading is outside this range, the user will be prompted to insure that the collection cone is not attached to a vehicle, and is sampling ambient air. A second attempt of the ambient collection will then occur. If the reading remains out of range, then a calibration of the dilute analyzer will be performed with the collection cone sampling ambient air. The ambient collection is repeated. When the ambient reading is

within range, the ambient value is recorded to VMAS™ and the test can proceed. If the ambient reading is still not within the desired range, the system shall be locked out with an appropriate message indicating that service is required.

The system shall automatically prevent an O2 calibration in the presence of exhaust.

7   Probe and Cone Hookups

The software shall prompt the inspector to place the exhaust collection system. If dual exhaust, the RI2000 shall instruct the operator to attach the dual exhaust collection hoses and cones. The software shall prompt the inspector to:

DISPLAY PROMPT:

INSERT THE SAMPLE PROBE(S) AND ATTACH THE CONE (S)

8   Tire Drying

If the test vehicle tires must be dried before the emission testing, the analyzer shall prompt the inspector as follows:

DISPLAY PROMPT:

DO THE TIRES NEED DRYING? (YES/NO)

Programming Criteria:

i   If YES, the analyzer shall allow the inspector to run the vehicle at any speed below 30 mph after selection of the transmission gear. When the roll speed exceeds 1 mph, the screen shall display the following delay message, which shall include the seconds that must be waited until the test mode can begin.

DISPLAY PROMPT:

ONCE THE TIRES ARE DRY, YOU MUST WAIT _____ SECONDS PRIOR TO BEGINNING THE TEST MODE.

The software shall increment the above second timer one second at a time until the rolls are brought to a stop (speed reaches 1 mph or less). If the vehicle speed exceeds 30 mph during tire drying, the timer shall increment twice a second until the speed is brought below 30 mph. When the rolls come to a stop, the above timer shall decrement once every second until the time reads zero before the RI2000

allows the driver to start the test mode.

ii   If NO, the analyzer shall proceed to the next step in the testing procedure.

iii   The response (Y = Yes, N = No) shall be written to the Tire Drying field of the test record. This field shall be filled for all TRANSIENT test records. (For two-speed test records, the field shall remain blank.)

9   Accessories

A prompt shall indicate that all accessories (air conditioning, heater, defogger, radio, automatic traction control if switchable, etc.) shall be turned off (if necessary, by the inspector).

10   Operating Condition

A prompt shall indicate that the vehicle shall be at proper operating condition prior to the start of the test. The vehicle temperature gauge, if equipped and operating, shall be checked to assess temperature. Vehicles in overheated condition shall be turned away from testing.

11   Negative Values

Negative grams-per-second calculations shall be recorded as such in the real time (second-by-second) emission data, but shall be integrated (summed) as zero (0.0) in any and all summations of second-by-second emission data to compute mode, phase, composite or other such summed emissions over time. Negative grams-per-second calculations shall also be converted to zero (0.0) value in any graphic representation of emissions that may be printed with emission test results provided to the motorist and the repair facility. Computer software shall allow the examination of any and all negative grams-per-second calculation data for quality assurance purposes.

12   Ambient Conditions

The ambient temperature, absolute humidity, and barometric pressure shall be recorded at a minimum rate of 1 Hz for ten seconds, within a time window of two minutes, prior to the start of each emissions test. The average value for each parameter over the ten second measurement period shall be used in all applicable emission calculations for the following test.

b   *General Procedure for all TSI cycles*

1   Safety Checks

The software shall prompt the inspector to perform any equipment manufacturer-required safety checks. The RI2000 shall display an option to abort the test at this point if the vehicle does not pass the equipment manufacturer-required safety checks, as indicated by the inspector.

2   Accessories

A prompt shall indicate that all accessories (air conditioning, heater, defogger, radio, automatic traction control if switchable, etc.) shall be turned off (if necessary, by the inspector).

3   Operating Condition. A prompt shall indicate that the vehicle shall be at proper operating condition prior to the start of the test. The vehicle temperature gauge, if equipped and operating, shall be checked to assess temperature. Vehicles in overheated condition shall be turned away from testing.

4   Ambient Conditions

The ambient temperature shall be recorded at a minimum rate of 1 Hz for ten seconds, within a time window of two minutes, prior to the start of each emissions test. The average value for each parameter over the ten second measurement period shall be used in all applicable emission calculations for the following test.

5   RPM

The software shall prompt the inspector to select the RPM pick-up type to be used while performing the emissions test. See Engine RPM Detection section.

DISPLAY PROMPT:

SELECT RPM PICK-UP DEVICE:

1. **CONTACT**

2. **NON-CONTACT**

3. **OBD-II PORT**

4. **OTHER**

Programming Criteria:

i   The RI2000 may provide additional prompts or submenus to guide the inspector for proper RPM

pickup connection.

ii   The RI2000 will prompt for an OBD II connection for all vehicle model years and newer of the vehicle model year identified in the NETWORK.DAT OBDII Model Year field. The default model year shall be 1996.

iii   The inspector shall be given the opportunity to select another RPM pick-up device and continue with the current inspection (without causing test to abort), if the engine RPM is not detected.

iv   RPM shall be displayed during the emissions test. Instability shall be immediately detected and displayed on the screen.

DISPLAY PROMPT:

UNSTABLE RPM SIGNAL - - CHECK OR CHANGE PICK UP

v   A stable RPM signal is required to complete the emissions test. The manufacturer may propose an error tolerance factor to be used when testing vehicles with unstable RPM signal.

c   *General Procedure for all TSI and Transient Test Cycles*

RPM criteria only applies to the TSI tests. The roll speed criteria only applies to dynamometer testing. The following conditions must be present before the RI2000 begins the test sequence:

1   Programming Criteria:

i   If the *Dual Exhaust* field of the test record is "Y", then the software shall prompt the inspector to attach the dual probe and hose assembly. Print whether the exhaust is dual or single on the VIR.

DISPLAY PROMPT:

YOU HAVE SELECTED DUAL-EXHAUST. CONNECT DUAL PROBE AND ASSEMBLY NOW.

ii   If the *Dual Exhaust* field of the test record is "N", continue the inspection.

iii   The dilution threshold is within the limits (for TSI tests, CO+CO2 >= CO+CO2 Dilution Limit field in TSISTD.DAT, and for transient tests, CO+CO2 >= 5%).

iv   The RI2000 does not detect a "low-flow" condition.

v   The engine idle speed is between 400 and 1250 RPM. (TSI only)

d   *Start TSI and Transient Testing*

Once all conditions have been met, display the following prompt:

DISPLAY PROMPT:

PROCEED WITH (TRANSIENT, TWO-SPEED IDLE) TEST.

Programming Criteria:

i   The RI2000 shall display the appropriate test information on the screen (test time, engine RPM, vehicle speed, etc.)

ii   The test shall be run with *Fuel Type 1* (TEST.DAT), and all results shall be stored in the Fuel Type 1 result fields in TEST.DAT. If Fuel Type 2 in TEST.DAT is not blank, display the following prompt:

DISPLAY PROMPT:

RUN TEST USING (FUEL TYPE 1). ENSURE THE VEHICLE IS OPERATING ON THE PROPER FUEL TANK.

iii   Once the test is completed, if *Fuel Type 2* in TEST.DAT is not blank, the test shall be repeated using the fuel type indicated by *Fuel Type 2*. The results of the second test shall be stored in the Fuel Type 2 result fields in TEST.DAT.

DISPLAY PROMPT:

RUN TEST USING (FUEL TYPE 2). ENSURE THE VEHICLE IS OPERATING ON THE PROPER FUEL TANK.

iv   To accommodate dual fueled vehicles, there are two sets of test result fields in TEST.DAT. Only data for tests on fuel code "G" (gasoline) shall be stored in TRNSBS (however, second-by-second results for all transient tests shall be available for review during ATP). Two TESTDATA.DAT records shall be recorded, one for each fuel.

v   The inspector should be able to abort the inspection by pressing the "Escape" key. If the inspector presses the "Escape" key, the RI2000 shall display the

following message:

DISPLAY PROMPT:

ARE YOU SURE YOU WANT TO ABORT THIS TEST? (YES/NO)

> vi   The RI2000 shall display the appropriate test If the inspector enters Y, then the RI2000 shall abort the inspection. Update incomplete file.

3.6.15 Transient Loaded Mode Testing Sequence

Procedures will be configurable from the HCS (NETWORK.DAT, VLT.DAT). The NETWORK.DAT file will contain the network configuration parameters.   The maximum number of times a cycle can be performed is 6. The RI2000 shall contain one transient driving cycle for official tests, designated RI31.   Additionally, PE mode uses the RI240 transient driving cycle.

The dynamometer loading shall be based on the VLT and the NETWORK.DAT information.

(Note: PE testing requirement for RI2000 will be deferred until 03/01/2000).

(Note: Fast pass/fast fail requirement for RI2000 will be deferred until 03/01/2000).

The system shall be capable of enabling the addition of HCS configurable fast pass/fast fail algorithms (Reserved for future software updates).

(Note: Requirement for RI2000 to run test cycles multiple times will be deferred until 03/01/2000).

For all test modes (i.e. preconditioning, official test, postconditioning, 2nd Chance), the number of times a cycle was performed will be stored in the TEST.DAT file:

- # of Official Test Transient Drive Cycle
- # of Preconditioning Transient Drive Cycle
- # of Postconditioning Transient Drive Cycle
- Second Chance Type
- # of 2nd Chance Transient Drive Cycle

> a   *Test Sequence and Configuration*

Each mode shall be less than 600 seconds. If the mode goes over 600 seconds, it shall be restarted. Between each mode, the RI2000 shall allow a maximum of 10 seconds to download VMAS data and reinitialize for additional data collection.

Possible drive sequences consist of multiple test modes (preconditioning, official test, postconditioning, second chance, etc.).

If VLT parametric variables are populated in VLT.DAT, the VLT parametric variables shall override the NETWORK.DAT.

The following test sequence will be followed by the workstation.

1   Preconditioning - Provisions will be made in the software to configure the number of times to repeat the Preconditioning Transient Drive Cycle. The # of Preconditioning Transient Drive Cycle field (0-6) will be passed in the NETWORK.DAT file. If the number of times passed from the HCS is set to zero then there is no preconditioning performed. Otherwise the preconditioning cycle shall be performed (0-6) times. Preconditioning second by second data will not be transmitted to the HCS. Required data will be stored in TESTDATA.DAT.

2   Official Test - Provisions will be made in the software to configure the number of times to repeat the official test mode. The # of Official Test Transient Drive Cycle field (0-6) will be passed in the NETWORK.DAT file. Otherwise the Official Test cycle type shall be performed (1-6) times. If all constituents fall within passing limits for any official test cycle, the test shall be competed. The final test cycle performed during the Official test will stored as the Final Results fields in the TEST.DAT, if no second chance test is performed. The final cycle of the official test second by second data will be passed to the HCS even if second chance is performed. Additional required data will be stored in TESTDATA.DAT.

3   Postconditioning – If a vehicle fails the Official Test, it shall receive postconditioning. Provisions will be made in the software to configure the number of times to repeat the Postconditioning mode. The # of Postconditioning Transient Drive Cycle field (0-6) will be passed in the NETWORK.DAT file. If the number of times passed from the HCS is set to zero then there is no Postconditioning performed. Otherwise the Postconditioning cycle shall be performed (0-6) times. Postconditioning second by second data will not be transmitted to the HCS. Required data will be stored in TESTDATA.DAT.

4   Second Chance – The final test cycle performed in the second chance will be stored as the Final Results fields in the TEST.DAT. Second Chance Type (1-4) field will also be contained in the NETWORK.DAT file. Options for second chance algorithms are:

i   TBD.

ii   Perform one second chance cycle if all failing constituents are within YY% of the standard (Second Chance Cutpoint % field in NETWORK.DAT).

iii   Perform single second chance test for all failing vehicles.

iv   No second chance.

5   Program Evaluation Testing (PE) – Once all the above official tests are performed, the analyzer may be required to perform an additional test cycle depending on the HCS configuration parameter (PE Mode field of the CONFIG.DAT file). If the PE mode is set in the CONFIG.DAT to "Y", or if the inspection was entered through the QA Menu "PERFORM PE TEST', then the PE Test Cycle will be performed. PE mode consists of a 240-second drive cycle. The cycle will be performed once. The cycle will not serve as the official test score but all quality assurance features described in an official test must be applied. PE second by second data is NOT transmitted to the HCS.

b   *Vehicle Emission Test Cycle*

1   Driving Trace. The inspector shall follow an electronic, visual depiction of the time/speed relationship of the transient driving cycle (hereinafter, the trace). The visual depiction of the trace shall be of sufficient magnification and adequate detail to allow accurate tracking by the inspector/driver and shall permit anticipation of upcoming speed changes. The trace shall also clearly indicate gear shifts and any violation leading to a restart.

2   Vehicle Loading. The Vehicle Loading Equations utilize information from the VLT.DAT and NETWORK.DAT files.

The default horsepower values shall be obtained from the HCS in the DFLTHP.DAT file.

The following loading equations shall be applied:

Torque = 5252 × [applied hp @ actual mph] / [roll RPM]

Adjusted Track Road Load = TrackRoadLoad50 * VLT Dyno Load Multiplier for Test Cycle * VLT Dyno Load Multiplier for Mode.

$PAU\ POWER_{@\ OBS\ MPH} = ACC\ POWER_{@OBS\ MPH/S} + TRLHP_{@OBS\ MPH} - GTRL_{@OBS\ MPH} - PLHP_{@OBS\ MPH}$,

where:
$PAU\ POWER_{@\ OBS\ MPH}$ = Power applied by the PAU to accurately simulate a vehicle during a transient cycle

$ACC\ POWER_{@OBS\ MPH/S}$ = Power required to accelerate or decelerate vehicle inertia in excess of dynamometer base inertia = Obsmph * 5280 / 3600 *ACC FORCE / 550

where:
ACC FORCE = E MASS * ACCELERATION (MPH/SEC) * 5280 / 3600

Obsmph = Observed vehicle speed
E MASS = The portion of the vehicle mass that must be simulated electrically
E MASS = (VEHICLE WEIGHT - BASE INERTIA) / 32.2
Multiply vehicle weight by 1.015 if two-wheel drive vehicle (for non-drive wheel rotating inertia)

$TRLHP_{@OBS\ MPH}$ = Power absorbed by drag on the vehicle = $AV * (Obsmph) + BV * (Obsmph)^2 + CV * (Obsmph)^3$

where:
AV = (AVPF / 50) * TRLHP@50
BV = (BVPF / 2500) * TRLHP@50
CV = (CVPF / 125000) * TRLHP@50

where:
TRLHP@50 = Track road load horsepower at 50 mph
AVPF = 0.35
BVPF = 0.1
CVPF = 0.55

$GTRL_{@OBS\ MPH}$ = Power absorbed at the tire/dyno roll interface = $At * (Obsmph) + Bt * (Obsmph)^2 + Ct * (Obsmph)^3$
$PLHP_{@OBS\ MPH}$ = Dynamometer parasitic loss horsepower

Programming Criteria:

1)   If the applied dynamometer horsepower must be

calculated, use the following procedure:
Calculate the curve coefficients necessary to properly characterize the tire/roll interface losses.

```
At = (0.xx/50) × (GTRL@50mph)
Bt = (0.yy/2500) × (GTRL@50mph)
Ct = (0.zz/125000) × (GTRL@50mph)
At8= (0.76/50) × (-.378193 + (0.0033207 × DAXWT))
Bt8= (0.33/2500) × (-.378193 + (0.0033207 × DAXWT))
Ct8= (-0.09/125000) × (-.378193 + (0.0033207 × DAXWT))
```

where:

- A_t, B_t, C_t are curve coefficients necessary to properly characterize the tire/roll interface losses.

- A_{t8}, B_{t8}, and C_{t8} are curve coefficients when using twin 8.625 inch diameter rolls.

- DAXWT is the drive axle weight.

2)   Using the curve coefficients established above, determine the GTRL for the actual mph using the following equation:

$$GTRL_{@Obmph} = (A_t \times (Obmph))+(B_t \times (Obmph)^2) + (C_t \times (Obmph)^3)$$

Where GTRL@Obmph = Generic Tire/Roll Interface losses at the observed mph.

3   Shift Schedule.

i   To identify gear changes for manual shift vehicles, the driving display presented to the inspector/driver shall be designed according to the shift schedule in Appendix III, and prominently display visual cues where the inspector/driver is required to change gears.

Gear shifts shall occur at the points in the driving cycle where the specified speeds are obtained. For vehicles with fewer than six forward gears the same schedule shall be followed with shifts above the highest gear disregarded.

ii   Automatic shift vehicles with overdrive or fuel economy drive modes shall be driven in those modes.

4   Speed Excursion Limits. Speed excursion limits shall apply

as follows:

i   The upper limit is 2 mph higher than the highest point on the trace within 1 second of the given time. (4 mph and 2 seconds for post/pre conditioning)

ii   The lower limit is 2 mph lower than the lowest point on the trace within 1 second of the given time. (4 mph and 2 seconds for post/pre conditioning)

iii   Vehicle speed excursions beyond tolerance limits given in items a. and b. above are acceptable provided that each such excursion is not more than 2 seconds in duration. (4 seconds for post/pre conditioning)

iv   A transient emissions test shall retested if the speed excursion limits are exceeded, except in the event that computer algorithms, approved by RI, determine that the conditions above are applicable. Tests may be aborted if the speed excursion limits are exceeded. *(In the event that computer algorithms do not demonstrate acceptable performance, the Program Administrator reserves the right to allow station managers with proper training to make a manual computer entry to invoke the stated provision. System software must be able to accommodate any such change.)*

5   Speed Variation Limits. The following calculations and criteria shall be applied to the vehicle speed data at the conclusion of each emission test:

i   A least-squares linear regression of actual vehicle speed (the 1-second average speed values) on target vehicle speed (the speed values from the cycle time/speed trace) shall be performed to yield the best fit equation having the form: $y = mx + b$, where:

y = actual vehicle speed (1-second average vehicle speed values, mph)

x = target vehicle speed (test cycle 1-second interval speed values, mph)

m = slope of the regression line

b = the y-intercept of the regression line

ii   The standard error of estimate (SE), slope (m), intercept (b), and correlation coefficient (r) of the linear regression of actual speed (y) on reference speed (x) shall be calculated for each transient cycle. A

transient driving cycle shall be repeated under any of the following conditions:

Test Criteria

1. Measured Test SE > SE Limit

2. Measured Test M > M Upper Limit

3. Measured Test M < M Lower Limit

4. Measured Test B > B Upper Limit

5. Measured Test B < B Lower Limit

The limits for all transient drive cycle types are passed in the NETWORK.DAT.

iii   The R2 criteria does not apply to post/pre conditioning cycles.

6   Distance Criteria. The actual distance traveled for the transient driving cycle shall be measured. If the % difference between the measured distance and the theoretical distance for the actual test exceeds 3% miles, the test shall be restarted, and the vehicle shall be retested. This criteria does not apply to post/pre conditioning cycles.

7   Additional Restart Conditions

i   VMAS not ready.

ii   VMAS low flow alarm

iii   Bench low flow.

iv   Instantaneous/Overall HP Error

v   Dilute low flow. Restart test if dilute flowrate drops below 200 ACFM (not SCFM) for 5 consecutive seconds.

vi   Low Exhaust flow. Restart test if exhaust flow drops below 5 SCFM for 15 consecutive seconds. Insures that collection cone is on the tailpipe.

vii   Negative dilution ratio. Indicates ambient reading is incorrect. Restart test after 3 consecutive seconds.

viii   Dilution ratio denominator < 2. Indicates raw probe is not in tailpipe, or raw O2 analyzer has malfunctioned. Restart test after 3 consecutive seconds.

8   Inertia Weight Selection. Operation of the inertia weight selected for the vehicle shall be verified as specified in section 3.1.4.d. For systems employing electrical inertia simulation, an algorithm identifying the actual inertia force

applied during the transient driving cycle shall be used to be determine proper inertia simulation. For all dynamometers, if the observed inertia is more than 1% different from the required inertia, the test shall be aborted. If the inertia weight selection test results in an aborted test, then the lane shall be closed until the inertia weight selection function is corrected. The test vehicle may be moved to another lane, if available, and retested. This criteria does not apply to post/pre conditioning cycles.

9   Verification of Dilute and Non-Dilute Exhaust Flow Measurements.

    i   Dilute flowrate shall not drop below 200 ACFM for more than 5 consecutive seconds during a test. Adequate flowrate will be verified prior to the start of a test. A typical system with proper hoses in good condition, with no sharp bends, will flow approximately 300 ACFM or higher.

    ii   Non-dilute flowrate shall not read less than 5 SCFM for more than 15 consecutive seconds. This is to insure exhaust collection cone is on the tailpipe at all times during a test.

10   Fuel Economy. For each test, the health of the overall analysis system shall be evaluated by checking a test vehicle's fuel economy for reasonableness, relative to upper and lower limits, representing the range of fuel economy values normally encountered during the program. Fuel economy shall be checked on a per-cycle basis, not second-by-second. For each VLT row ID, the fuel economy limits shall be determined using AVGCYCLE.DAT. Exceeding the limits (measured fuel economy > max fuel economy in the AVGCYCLE.DAT file), when applied to passing vehicles, will result in a restart. Exceeding the fuel economy limit (measured fuel economy > max fuel economy in the AVGCYCLE.DAT file) for failing vehicle shall result in a warning on the VIR. This criterion does not apply to post/pre conditioning cycles. Fuel economy shall be based on the distance driven, not the distance of the trace. Measured fuel economy shall be calculated as follows (note that this fuel economy calculation applies only to vehicles running on gasoline):

If:

$CW = 0.86$	is the Carbon weight factor

`SG = 0.7386`	is the Specific weight of fuel (gasoline in this case)
`CWFco = 0.429`	is the Carbon weight fraction of CO
`CWFco2= 0.273`	is the Carbon weight fraction of CO2
`NHV = 18500.5`	is the Net Heating Value
`RF = 0.6`	is the R-factor (accounts for sensitivity of fuel consumption to the heat energy of the test fuel. EPA currently uses 0.6.

Then Fuel Economy (in mpg) =

$$\frac{(51740000 \text{ x CWF *SG})}{((\text{CWF x HC}) + (\text{CWFco x CO}) + (\text{CWFco2 x CO2})) \text{ x } (\text{Rf x SG x NHV} + 5471)}$$

As long as:

`((CWF x HC) + (CWFco x CO) + (CWFco2 x CO2)) x (Rf x SG x NHV + 5471) > 0.`

Fuel economy as printed on the VIR shall be calculated as follows:

Fuel economy = measured fuel economy x fuel economy correction factor, where fuel economy correction factor comes from NETWORK.DAT.

11   Emission Measurements. During the transient driving cycle, the emission analysis system shall continuously sample and record exhaust.   All emission measurements and calculations shall be appropriately corrected to standard temperature and pressure conditions. Standard temperature and pressure conditions for RI2000 are defined as 68 F and 760 mm Hg (1 atmosphere).

12   Restart Procedures. Bring the rollers to a full stop. Reset the test timer to zero. Upon restart, the previously captured second-by-second data shall be deleted and data collection shall begin anew. Restart shall cause the current cycle to be restarted. The VMAS™ shall be reset upon restart. Restart conditions apply to all test modes unless specifically stated otherwise.

DISPLAY PROMPT:

TEST MODE MUST BE RESTARTED BECAUSE:

a)   The RI2000 shall include in the above prompt a description of the restart condition. The software shall count the number of restarts during the test procedure. The count shall be written to the *Restart Counter* field of the test record. The maximum number of restarts is 3, otherwise the test will be aborted. Transient tests with no restarts will record zero in the appropriate field.

b)   Conditions Causing Test Mode Abort:

1) Safety-related issues

2) Equipment failure

3) Power loss

4) Exhaust overflow. If both raw and dilute O2 readings are less than 5%. Indicates that dilute flowrate is insufficient to capture all exhaust. Abort test after 3 consecutive seconds.

5) Dilute flow Over Temperature. Temperature limit is 350F. Abort test after 3 consecutive seconds.

6) If the system measures lower than 200 SCFM for 3 consecutive seconds, the test shall be aborted.

7) Any of the restart conditions listed above occurring more than 3 times.

13   Data: The transient SBS data for the final 1st and 2nd chance tests shall be transmitted to the HCS in the TRNSBS.DAT file.

c   Augmented Braking

Augmented braking shall be used during vehicle decelerations on the driving cycle. Augmented braking shall be actuated as follows:

1   only when the negative force applied by the vehicle at the roll surface is greater than 110 pounds; or,

2   If the monitored deceleration is greater than or equal to 1 mph/second, a load proportional to the rate of deceleration shall be applied.

d   End of Emissions Test Mode

At the completion or termination of the transient inspection, the analyzer

shall display the following message:

DISPLAY PROMPT:

END OF EMISSIONS TEST

3.6.16 Emissions Sampling Period For Two-Speed Idle Test Only

Immediately before starting the two-speed idle emissions test, the software shall require the operator to verify that the type of ignition system entered is correct and allow the inspector to change it if it is incorrect.

a   *The sampling period shall commence as soon as stability is achieved. Stability is achieved when all of the following conditions are satisfied:*

1.   Averaged reading for $CO+CO_2$ over a period of two seconds meet the dilution threshold;

2.   Engine RPM has been within specified thresholds for at least one second; and

3.   Sample flow rate is adequate to prevent triggering the low flow lockout.

b   *After stability has been achieved and sampling has been initiated, if any of the following conditions occur, the test mode must be restarted:*

1.   The dilution level is below the specified threshold.

2.   Engine RPM is outside the specified thresholds.

3.   Sample flow rate is not adequate to prevent triggering the low flow lockout.

c   *Exceeding the RPM limits, not reaching the dilution threshold or a low flow rate during a testing period shall automatically cause the testing period to restart for that mode.*

d   *For Fuel Types P and N (LPG/CNG), the dilution threshold shall be 2% less than the dilution limit in TSISTD.DAT. For example, if dilution limit in TSISTD.DAT is 6%, the dilution limit shall be 4% for fuel type P or N.*

3.6.17 Two-Speed Idle Testing Sequence

Two-speed idle testing shall be used for all vehicles that can not be tested on the dynamometer.

a   *The following testing/sampling sequences shall be available in the software at the time of certification:*

<u>SEQUENCE #1</u>:

Testing period: 30 seconds for each stage

First stage: 2500 RPM (± 10 %)

Second stage: Idle RPM

Basis for test results: Average of last 5 seconds of each sampling period.

Units of test results: Concentration measurements: PPM HC, % CO, % O_2 and % CO_2.

Test Sequence # 1 shall be used to test all vehicles except those mentioned under the test sequences below.

SEQUENCE #2:

Testing period: 30 seconds for each stage

Note: Prior to initiating the test, the inspector shall be informed that the vehicle they will be testing will require special test procedures and that it is important to follow directions carefully. The inspector shall then be prompted to turn the key off for 10 seconds. At the end of 10 seconds, the analyzer shall prompt the inspector to restart the engine and begin the 2500 RPM test. The software shall ensure that there is no RPM signal for 10 seconds prior to starting the 2500 RPM test.

First stage: 2500 RPM (±10 %)

Note: Between the test stages, the inspector shall be prompted to turn the ignition off for 10 seconds. The analyzer shall ensure that there is no engine RPM signal for at least 10 seconds. At the end of 10 seconds, the software shall prompt the inspector to restart the engine and begin the idle test.

Second stage: Idle RPM (see standards for maximum)

Basis for test results: After the first 15 seconds of each stage, any passing reading (averaged over 5 consecutive seconds) collected during each sampling period or if none, over the last 5 seconds.

Units of test results: Concentration measurements: PPM HC, % CO, % O_2 and % CO_2

Test sequence #2 could take as little as 20 seconds if test conditions are satisfied and the vehicle meets the standards. If the emissions are not within the standards for any 5-second period (following the initial 15-second period), the test shall run the full 30 seconds.

All 1981-84 Ford passenger cars with 5.8L (351 CID) engines shall be tested using Sequence # 2.

SEQUENCE #3:

Testing period: 30 seconds for each stage

Note: Before the 2500 RPM test starts, the software shall display a message to the inspector indicating that the engine RPM cannot exceed 2650 for this vehicle.

First stage: 2500 RPM (+ 6 % , - 10 %)

Second stage: Idle RPM (see standards for maximum)

Basis for test results: Average of the last 5 seconds of each sampling period.

Units of test results: Concentration measurements: PPM HC, % CO, % O_2 and % CO_2

All 1984 Jeeps with a 2.5L (150 CID) light-duty trucks shall be tested using test Sequence # 3.

SEQUENCE #4:

Testing period: 30 seconds for each stage

First stage: 2500 RPM (±10 %)

Note: A message shall be displayed to the inspector indicating that the vehicle being tested will require special test procedures and that it is important that they follow directions carefully. The RI2000 shall display the following prompt:

DISPLAY PROMPT:

IS THE VEHICLE FUEL INJECTED? (YES/NO)

1   Programming Criteria:

      i   If Yes, perform test sequence # 4.

      ii   If No, follow inspection sequence # 1.

The inspector shall be prompted to set the parking brake, press the brake pedal and run the IDLE test with the transmission in DRIVE. When the idle test is complete, the inspector shall be prompted to return the transmission to PARK.

Second stage: Idle RPM (see standards for max.)

Basis for test results: Average of last 5 seconds of each sampling period.

Units of test results: Concentration measurements: PPM HC, % CO, % O2 and % CO2

All 1984 Chrysler/Dodge/Plymouth passenger cars with a 2.2L, fuel-injected engines with automatic transmissions shall be tested using Sequence # 4.

SEQUENCE #5:

Given the problems with the ZF automatic transmission, Rhode Island recommends that the affected vehicles be tested at their dealerships. Accordingly, if the inspector enters an A (for automatic) for the transmission type, and if the vehicle make, model and model year match BMW/Peugeot/Volvo criteria, the RI2000 shall display the following message:

BECAUSE OF THE POSSIBILITY OF TRANSMISSION DAMAGE TO THIS VEHICLE, IT IS RECOMMENDED THAT THE VEHICLE BE INSPECTED AT ITS DEALERSHIP. IF YOU STILL WISH TO PERFORM THE INSPECTION, YOU MAY DO SO AT YOUR OWN RISK OR YOU MAY ABORT THE TEST.

Note: If the inspector chooses to continue testing this vehicle, display the following message before beginning the test sequence.

BEFORE BEGINNING THE EMISSIONS TEST, MAKE SURE THE ENGINE IS AT NORMAL OPERATING TEMPERATURE. IF NOT, THE VEHICLE SHOULD BE DRIVEN UNTIL IT IS. DO NOT WARM THE ENGINE BY RAISING THE RPM ABOVE IDLE WHILE THE TRANSMISSION IS IN PARK OR NEUTRAL.

Perform idle test only (delete first stage).

Testing period: 30 seconds for idle stage

Engine Speed: Idle RPM [Note: One stage only.]

Basis for test results: Average of the last 5 seconds of the sampling period.

Units of test results: Concentration measurements: PPM HC, % CO, % O2 and % CO2

Note: All 1984-87 BMWs with automatic transmission, 1983-88 Volvo 740s with automatic transmission, and 1986-92 Peugeot 505s with automatic transmission shall be tested using test Sequence #5. If the engine has been changed to a different year, the special test sequence shall follow the year of the vehicle.

Example:

*   1985 BMW with a ZF transmission and original engine uses test sequence #5 and the emission standards for 1985.

*   1985 BMW with a ZF transmission and a 1990 engine uses test sequence #5 and emission standards for 1990.

SEQUENCE #6:

Testing period: 30 seconds for each stage

First stage:　　　　　　　　2500 RPM (±10%)

Second stage:　　　　　　　Idle RPM

Basis for test results:

　　Stage 1:　　　Average of last 5 seconds of sampling period.

　　Stage 2:　　　Same as stage 1; however, if the emissions are not within the standards and the idle RPM was below 900, then the inspector shall be prompted to rev the engine so that the idle speed is a minimum of 900 RPM (but not to exceed the manufacturer's specifications), and to continue the test for another 30-second Second-Stage Idle Test. After the first 15 seconds of the repeated second stage, any passing reading (averaged over 5 consecutive seconds) collected during the sampling period, or, if none, the average reading over the last 5 seconds of the stage.

Units of test results:　　　Concentration measurements: PPM HC, % CO, % O2 and % CO2

All 1985 Ford Ranger 2.3L (140 CID) light duty trucks and 1986 Ford Ranger and Aerostar 2.3L (140 CID) light duty trucks shall be tested using test sequence #6.

SEQUENCE #7:

Testing period:　　　　　　25 seconds for each stage

Note: Prior to beginning the first stage, the inspector shall be informed that the vehicle he/she will be testing will require special test procedures and that it is important to follow directions carefully (this information shall not be displayed prior to the "second-chance" test if preconditioning is required). The inspector shall then be prompted to ensure the tach lead is connected, start the vehicle and allow it to idle. At the end of 156 seconds, the analyzer shall prompt the inspector to insert the probe and begin the 2500 RPM test. The software shall ensure that there is an RPM signal for 156 seconds prior to starting the 2500 RPM test. This 156-second warm-up shall not be required prior to the "second-chance" test if preconditioning is required.

First stage:　　　　　　　　2500 RPM (±10 %)

Second stage:　　　　　　　Idle RPM (see standards for maximum)

Basis for test results:　　After the first 10 seconds of each stage, averaging shall begin. Any passing reading (averaged over 5 consecutive seconds) collected during each sampling period or if none, over the last 5 seconds.

Units of test results: Concentration measurements: PPM HC, % CO, % O2 and % CO2

Test Sequence #7 could take as little as 15 seconds if test conditions are satisfied and the vehicle meets the standards. If the emissions are not within the standards for any 5-second period (following the initial 15-second period), the test shall run the 25 seconds.

All 1984-1986 GM passenger cars with VIN-Y ("Y" in eighth position of the VIN) engines shall be tested using Sequence # 7.

b   *Accommodations shall be made to allow for additional test sequences and sampling periods, which can be added at a later date.   Based on information in the TSI Test Sequence field of the VLT, the following test sequence may be performed instead of the standard TSI test sequences listed above.*

SEQUENCE #8:

Testing period: 25 seconds for each stage

Note: Prior to initiating the test, the inspector shall be informed that the vehicle they will be testing should be at normal operating temperature prior to starting the test. The inspector shall then be prompted to start the vehicle, snap the throttle and allow the throttle plate to snap closed. The analyzer shall prompt the inspector to insert the probe and begin the 2500 RPM test.

First stage: 2500 RPM (±10 %)

Second stage: Idle RPM (see standards for maximum)

Basis for test results: After the first 10 seconds of each stage, averaging shall begin. Any passing reading (averaged over 5 consecutive seconds) collected during each sampling period or if none, over the last 5 seconds.

Units of test results: Concentration measurements: PPM HC, % CO, % O2 and % CO2

Test Sequence #8 could take as little as 15 seconds if test conditions are satisfied and the vehicle meets the standards. If the emissions are not within the standards for any 5-second period (following the initial 10-second period), the test shall run the 25 seconds.

All vehicles designated in the VLT with an "8" in the TSI Test Sequence field shall be tested using Sequence # 8.

c   *The test sequence number shall be documented in the TSI Test Sequence field of the test record and the VIR.*

d   *When the vehicle has met RPM, flow rate and dilution conditions, the emissions test sequence shall begin and the display shall show the word TESTING and time remaining in the test sequence. The analyzer shall record the emission readings at the end of the TESTING period, for each test mode.*

e   *For vehicles that have had engine changes, special test sequences shall follow the year of the engine, except special test sequence #5.*

Example:

A 1980 Ranger with a 1985 2.3L engine uses special test sequence #6 and emission standards for 1985.

3.6.18 Vehicle Preconditioning Sequence For Two-Speed Idle Test

If a vehicle fails any of the TSI emission tests, the analyzer shall instruct the inspector to precondition the vehicle and run a second chance test. The RI2000 shall also use special test sequences for the second chance test if they were used for the first test. For example: if the RI2000 uses special test sequence #2 and the vehicle requires preconditioning, the RI2000 shall use special test sequence #2 for the second chance test. The RI2000 shall also follow any RPM restrictions that the special test sequence may require, i.e., a 1985 BMW with a ZF transmission shall NOT be preconditioned at high RPM. Based on the surveys conducted on suspected pattern failures by the EPA, all model vehicles failing an initial test shall be preconditioned in the following manner, and retested:

DISPLAY PROMPT:

REMOVE THE EXHAUST PROBE FROM THE TAILPIPE.

a   *PROCEDURE #1:*

For All Vehicles Except Those Covered by Procedures 2 and 3

OPERATE THE VEHICLE AT 2500 ±300 RPM FOR THREE MINUTES WITH THE TRANSMISSION IN "PARK" OR "NEUTRAL."

AT THE END OF THE THREE-MINUTE PERIOD, ALLOW THE VEHICLE TO RETURN TO IDLE AND STABILIZE FOR 10 SECONDS, BUT DO NOT TURN THE IGNITION SWITCH OFF.

INSERT THE PROBE INTO THE TAILPIPE.

AT THE END OF THE 10-SECOND PERIOD, IMMEDIATELY BEGIN THE EMISSIONS TEST.

1   Programming Criteria For Procedure # 1

Within 30 seconds of having completed the three-minute portion of the preconditioning sequence, the inspector shall release the throttle, insert the probe and return the engine to

2500 (±250) RPM. The 30-second time period shall begin when the engine RPM drops below 2200. The RI2000 shall provide prompts indicating when the inspector should release the throttle, insert the probe and increase the engine RPM to the appropriate range as specified as soon as the probe has been inserted. The emissions test sequence shall begin as soon as the engine RPM reaches the appropriate range. The RI2000 shall display the time remaining before the preconditioning period will have to be restarted or the test aborted.

b   *PROCEDURE #2:   For 1981-86 Fords/Lincolns/Mercurys and 1984-85 Honda Preludes*

OPERATE THE VEHICLE AT 2500 ±300 RPM FOR 3 MINUTES WITH THE TRANSMISSION IN "PARK" OR "NEUTRAL."

AT THE END OF THE 3-MINUTE PERIOD, ALLOW THE VEHICLE TO RETURN TO IDLE AND IMMEDIATELY TURN THE IGNITION KEY OFF.

INSERT THE PROBE INTO THE TAILPIPE.

LEAVE THE IGNITION OFF FOR 10 SECONDS THEN RESTART THE ENGINE AND PROCEED IMMEDIATELY WITH THE EMISSIONS TEST.

1   Programming Criteria For Procedure # 2

Within 30 seconds of having completed the three-minute portion of the preconditioning sequence, the inspector shall release the throttle, turn off the ignition for at least 10 seconds, insert the probe and return the engine to 2500 (±250) RPM. The 30-second time period shall begin when the engine RPM drops below 2200. The RI2000 shall provide prompts indicating when the inspector should release the throttle, turn the ignition key off, insert the probe, and to restart the engine and immediately increase the engine RPM to the appropriate range as specified. The emissions test shall begin as soon as the engine RPM reaches the appropriate range. The RI2000 shall display the time remaining before the preconditioning period will have to be restarted or the test aborted.

c   *PROCEDURE #3: For "ZF" Automatic Transmission*

Given the problems with the ZF automatic transmission, Rhode Island prefers that the affected vehicles be tested at their dealerships. Accordingly, if the inspector enters an A (for automatic) for the transmission type, and if the vehicle make, model and model year match BMW/Peugeot/Volvo criteria, the RI2000 shall display the following message:

DISPLAY PROMPT:

BECAUSE OF THE POSSIBILITY OF TRANSMISSION DAMAGE TO THIS VEHICLE, RI PREFERS THAT IT BE INSPECTED AT ITS DEALERSHIP. IF YOU STILL WISH TO PERFORM THE INSPECTION, YOU MAY DO SO AT YOUR OWN RISK. PRESS "ENTER" TO CONTINUE. IF NOT, PRESS "ESC" TO ABORT THE TEST.

For all 1984-1987 BMWs with automatic, 1986-92 Peugeot 505s with automatic, and 1983-88 Volvo 740s with automatic transmission.

If these vehicles fail the first chance, display the following message:

DISPLAY PROMPT:

DUE TO POSSIBLE SERIOUS TRANSMISSION DAMAGE, DO NOT RAISE THE ENGINE SPEED ABOVE IDLE RPM WHILE THE TRANSMISSION IS IN NEUTRAL OR PARK. IF THE VEHICLE NEEDS TO BE PRECONDITIONED, DRIVE IT UNTIL IT HAS REACHED OPERATING TEMPERATURE.

The analyzer shall start the second chance test as soon as the RI2000 detects engine RPM within the idle RPM range. The RI2000 shall perform the emissions measurement at idle for 30 seconds. After the second chance, the RI2000 shall allow the inspector to continue with the remainder of the inspection.

d   *Programming Criteria For All Procedures:*

The manufacturer shall provide for the capability to utilize as many different preconditioning procedures as can be contained in the analyzer. The preconditioning procedure number shall be recorded on the test record in the TSI Preconditioning Procedure field.

1   **For all procedures** - The analyzer shall automatically instruct the inspector to initiate the preconditioning procedure whenever a vehicle fails the emissions test before the test can proceed. The analyzer software shall select and display only the appropriate preconditioning procedure based on the vehicle make and model year information entered by the inspector.

2   **For procedure # 1** - A message shall be displayed instructing the inspector to remove the exhaust probe and increase the engine RPM to 2500 (±300) and hold it there for 3 minutes. The analyzer shall detect a signal in the proper range for 3 minutes within a 3-minute and 15-second period, with no single excursion exceeding 5 seconds. A message

shall be displayed instructing the inspector to adjust the engine RPM, restart the test or abort the test as appropriate if the RPM is outside of the specified limits. The preconditioning period shall begin as soon as the engine RPM is stable (for a period of 1 second) and in the proper range. To avoid loading the sample system with vehicle exhaust during the preconditioning process, the analyzer shall either back purge during the preconditioning sequence or prevent preconditioning if the probe is in the tailpipe. Preconditioning prevention could be determined by checking for emissions prior to or during the preconditioning sequence.

When the preconditioning period is complete, the inspector shall be instructed to allow the vehicle to return to idle and the analyzer shall ensure that the engine speed is reduced for at least 10 seconds, but no more than 30 seconds. If the engine speed is reduced for less than 10 seconds or more than 30 seconds, a message shall be displayed instructing the inspector to either restart the preconditioning procedure or abort the test. Messages indicating the appropriate ignition key on/off and retest instructions shall be displayed at the end of the 10 second idle period. The inspector shall be instructed to strike the ENTER key as soon as possible after 10 seconds of idling has occurred.

3   **For all procedures** - The analyzer shall display the engine speed and the time remaining during each stage of the preconditioning sequence. The number of the preconditioning procedure shall be recorded on the test record automatically by the analyzer. If no preconditioning procedure was used (vehicle passed the emissions portion of the test the first time), this field shall be filled with a space.

4   ERROR MESSAGES:

DISPLAY PROMPT:

(For all procedures)

NO RPM SIGNAL - MAKE SURE THE TACH LEAD IS CONNECTED.

(For procedures 1 & 2)

ENGINE RPM DROPPED BELOW 2200 RPM -RAISE THE ENGINE SPEED TO 2500 RPM AND HOLD IT THERE FOR 3 MINUTES.

(For procedures 1 & 2)

**ENGINE RPM INCREASED ABOVE 2800 RPM-REDUCE
THE ENGINE SPEED TO 2500 RPM AND HOLD IT THERE
FOR 3 MINUTES.**

5   **For all procedures -** If a vehicle subject to preconditioning receives a second-chance test, the emissions results of both tests shall be stored in the test record. The results for either or both tests shall not be written to the test record until the pass/fail decision has been made by the RI2000.

The emission values from the first test should be stored in a manner determined by the RI2000 manufacturer until a pass/fail decision on the emissions values has been determined. If the emissions indicate a pass, the values from the first test shall be written to the Final Results fields of the TEST.DAT file, and the Before Preconditioning fields shall remain blank.

If preconditioning and a second chance emissions test is given, the second chance emissions values shall be written to the Final Results fields of the TEST.DAT file. The results of the first test, shall be written to the *Before Preconditioning* fields of the TEST.DAT file.

3.6.19 Diesel Testing

The Diesel VLT (DLT) and the Diesel Standards Table (DSLSTD) shall be used.

a   *Loaded Diesel Test Procedure*

1   Test Preparation

The system will prompt the operator to perform the following functions:

i   Ensure there is no hazardous vehicle or dynamometer condition prior to driving vehicle onto the dynamometer. Abort test at any time if any such unsafe condition is occurring or can occur.

ii   Check engine oil level. The level must be within 1 quart of required level. Correct before proceeding with test.

iii   Turn off all vehicle accessories.

iv   Driving vehicle onto the dynamometer.

v   Position drive wheels on the lift plate between the

rollers.

vi   Lower the lift.

vii   Center vehicle.

viii   Place chocks.

ix   Restrain vehicle.

x   Position fan towards the radiator air intake.

xi   Check to ensure vehicle is properly warmed up.

xii   Firmly hold steering wheel.

xiii   Do not test in overdrive.

2   Test Sequence

i   Dynamometer Controls

Set dynamometer controls as follows:

Target speed = 30 mph

ii   The Road Load Horsepower shall be attained from the DLT. If there is no DLT match, the default horsepower values shall be obtained from the following table:

Vehicle Type	Number of Cylinders	Actual Road Load Horsepower
All	3	8.3
All	4	9.4
All	5	10.3
All	6	10.3
LDV	8	11.2
LDT	8	12.0
LDV	10	11.2
LDT	10	12.7
LDV	12	12.0
LDT	12	13.4

iii   Gear Selection

The system will prompt the user to select the appropriate gear closest to direct drive.

iv   Test Cycle

The following procedure will be followed:

a)   The system will provide for appropriate prompts instructing the vehicle to be driven to 30 mph.

b)   The dynamometer will apply a load to the vehicle as it increases in speed.

c)   The system will provide a test screen that shows real-time test parameters to assist the inspector in achieving test conditions in an efficient manner.

d)   When the vehicle speed and dynamometer load are within $\pm$ 5% of target for 5 seconds (stabilization period), start sample timer.

e)   The system will automatically take opacity samples during a 15 second sample period.

NOTE: Should the vehicle speed and/or the dynamometer load exceed the $\pm$ 5% window during the sample period the sample period is terminated and the 5 second stabilization period is re-entered prior to re-starting the 15 second sample timer.

f)   Automatically record opacity readings. A 5 second running average of the opacity readings will be calculated by the RI2000 analyzer. The lowest average for the test period will be utilized as the final results.

3   Second Chance

If the vehicle fails the initial test, the RI2000 system shall repeat the test in its entirety. The results of the second test shall be used to determine the pass/fail status of the vehicle under test.

4   Data Storage

The emission values from the first test should be stored in a manner determined by the RI2000 manufacturer until a pass/fail decision on the emissions values has been determined. If the emissions indicate a pass, the values from the first test shall be written to the Loaded Diesel Final Results fields of the TEST.DAT file, and the 1st Chance(If Applicable) fields shall remain blank.

If preconditioning and a second chance emissions test is

given, the second chance emissions values shall be written to the Loaded Diesel Final Results fields of the TEST.DAT file. The results of the first test, shall be written to the 1st Chance (If Applicable) fields of the TEST.DAT file.

5   End of Test

The dynamometer shall assist the vehicle in reducing speed after the test has been completed or restarted. The system will prompt the operator to:

i   Remove foot from accelerator pedal

ii   Apply brakes gently-WARNING (see note)

iii   Bring vehicle speed to a complete stop before placing transmission in PARK

iv   Remove probe, cooling fan, wheel chocks, and restraints.

Note: Item 2 shall caution the operator in an appropriate manner (i.e., bright, flashing, etc.).

b   *Non-Loaded Diesel Test Procedure*

(Note: This requirement for RI2000 will be deferred until 03/01/2000.)

(Reserved - Requirements will be defined for startup implementation.)

3.6.20 *Repairs Performed Before Test*

a   *Pre-Inspection Repairs*

The RI2000 shall display the following prompt:

DISPLAY PROMPT:

WERE ANY EMISSIONS-RELATED REPAIRS PERFORMED PRIOR TO THE START OF THE INSPECTION? (YES/NO)

1   Programming Criteria:

i   If the inspector enters Y, the software shall write Y to the *Repairs Performed Before Test* field of the TEST.DAT and REPAIR.DAT files. Go to the next prompt under Subsection b.

ii   If the inspector enters N, the RI2000 shall go to Pass/Fail Determination section. The RI2000 shall store N in the *Repairs Performed Before Test* field of the test record. No repair record will be created.

b   *The RI2000 shall display the following prompt:*

DISPLAY PROMPT:

WERE THE REPAIRS PERFORMED AT YOUR SHOP? (YES/NO)

The response (yes or no) shall be recorded in the *Repairs Performed At Station* field of the REPAIR.DAT file.

> 1   Programming Criteria:
>
>> i   If the inspector enters Y, the RI2000 shall prompt as follows:

DISPLAY PROMPT:

DID YOU PERFORM THE REPAIRS? (YES/NO)

>> a)   If the inspector selects "Y" (for YES), then the RI2000 shall automatically store the inspector's license number in the *Repair Inspector License Number* field of the repair record and continue with the repair information entry process.
>>
>> b)   If the inspector selects "N" (for NO), then the RI2000 shall display the list of inspectors (Names and License Numbers only) that are stored in the TECH.DAT file and shall allow to scroll up or down in this list and select the inspector that has performed the repairs. The RI2000 shall store the inspector's license number in the Repair Inspector License Number field of the repair record. The RI2000 shall allow the inspector to select "Other" for repairs perfomed by a repair mechanic that is not a inspector at that shop. The RI2000 shall ask the inspector to enter the Repair Inspector License Number if other is selected. Go to Repair Action Categories.
>
>> ii   If the inspector enters N to the prompt "Were there repairs performed at your shop," ask the operator to enter the Repair Inspector License Number and Certified Repair Facility Station Number, if available, else the RI2000 shall proceed with the inspection process. The RI2000 shall prompt to check if the Repair Action Categories information is available. If available, go to the next section. If not available, go to Repair Cost Information.

3.6.21 Repair Action Categories

The RI2000 shall display the Repair Action Categories (Level 1). All repair-

related information shall be stored in the repair record. The REPAIR.DAT file will be utilized. The Repair Code Order field in the table below dictates in which order the repair codes shall be stored. Upon selection of a Repair Action Category, the RI2000 shall display the appropriate items in the next level, as indicated by the table called Repair List in Appendix I. When the Entry Level items are displayed, the RI2000 shall display the following message:

DISPLAY PROMPT:

ENTER ONE OF THE FOLLOWING CODES FOR EACH OF THE EMISSION-RELATED SYSTEM ITEMS THAT HAVE BEEN DIAGNOSED AND/OR REPAIRED.

> **N - Recommended/Not Performed**
>
> **A - Adjusted**
>
> **W - Warranty**
>
> **L - Replaced**
>
> **P - Repaired**
>
> **or PRESS (FUNCTION KEY) TO BACK-UP ONE SCREEN**
>
> **REPAIR ACTION CATEGORIES**

a *Programming Criteria:*

1   The software shall only allow the letters to be entered for each applicable menu item. The inspector shall be able to go directly to the repair action category(s) of choice, without having to scroll through all of the menu items or back up one screen at a time. If an item is not selected, a blank space shall be recorded in the corresponding field of the repair record. Similarly, if a menu item is chosen and no value is entered, a blank space (indicating no action taken) shall be recorded to the repair record.

2   The RI2000 shall not allow the inspection to proceed without entering an appropriate repair code for at least one repair action category item. If there is no entry made for at least one repair action category item, the RI2000 shall display the following message.

> ### DISPLAY PROMPT:
>
> **WERE REPAIRS PERFORMED AT YOUR SHOP? (Y or N)**
>
> **IF YES, A REPAIR ACTION CODE ENTRY IS REQUIRED!**
>
> If Y, continue with repair action category function. If N, change the entry recorded in the *Repairs Performed Before Test* field of the test record from Y to N.

3   The RI2000 shall provide a review screen option to assist the inspector to view all repair category actions that have been entered.

3.6.22 Repair Cost Information

After the appropriate repair action codes have been entered, the RI2000 shall require entry of the repair cost information. The REPAIR.DAT file will be utilized. The software shall display the following message:

> ### DISPLAY PROMPT:
>
> **a) ENTER THE AMOUNT OF LABOR TIME SPENT BY A CRT (CERTIFIED REPAIR TECHNICIAN) OR A CIR (CERTIFIED INSPECTOR REPAIR TECHNICIAN) REPAIRING THE VEHICLE (ROUND TO THE NEAREST TENTH OF AN HOUR):**
>
> **TOTAL REPAIR TIME, HH.H HOURS**   _____
>
> **b) ENTER THE AMOUNT OF LABOR TIME SPENT BY A NON-CERTIFIED REPAIR TECHNICIAN REPAIRING THE VEHICLE (ROUND TO THE NEAREST TENTH OF AN HOUR):**
>
> **TOTAL REPAIR TIME, HH.H HOURS**   _____
>
> **c) ENTER THE TOTAL AMOUNT CHARGED FOR PARTS AND LABOR TO PERFORM EMISSION-RELATED REPAIRS. ENTER THE DOLLAR AMOUNT ONLY (ROUND TO THE NEAREST WHOLE DOLLAR). DO NOT INCLUDE ANY WARRANTY REPAIRS (EMISSION-RELATED OR NOT) AND/OR TAMPER REPAIRS.**
>
> **EMISSION-RELATED REPAIRS:**
>
> **PARTS COST$_____**

EMISSION-RELATED REPAIRS PERFORMED BY CRT/CIR:

 LABOR COST$_____

EMISSION-RELATED REPAIRS PERFORMED BY NON-CERTIFIED REPAIR TECHNICIAN:

 LABOR COST$_____

d) ENTER THE ESTIMATED COST OF ADDITIONAL EMISSIONS REPAIRS NOT PERFORMED (ROUND TO THE NEAREST WHOLE DOLLAR):

ESTIMATED COST OF ADDITIONAL REPAIRS $_____

e) ENTER THE STATION HOURLY LABOR RATE (ROUND TO THE NEAREST WHOLE DOLLAR):

HOURLY LABOR RATE $_____

a   Programming Criteria:

1   The software shall display the inspector's entries, but shall disregard any portion less than a whole dollar amount for the repair record.

2   The software shall provide a summary screen for the inspector to review the repair and diagnostic data entries. In addition, the software shall print the information on the VIR.

DISPLAY PROMPT:

IS THE INFORMATION CORRECT? (YES/NO)

3   If the information is incorrect, the software shall allow the inspector to make changes.

4   The software shall prompt for the hourly labor rate and write it to the *Hourly Labor Rate* field. Then the new hourly labor rate shall be stored in the repair record.

5   The software shall calculate the value for the *Total Cost Applicable Toward Waiver* field in REPAIR.DAT. The amount shall be the cost of labor done by a CRT or CIR plus the cost of the emission related repairs.

6   The software shall calculate the value for *the Emission Related Total Labor Cost* in REPAIR.DAT by adding the

CRT/CIR Labor Cost and Non-Certified Inspector Labor Cost entries.

3.6.23 *Pass/Fail Determination*

If the Emission Test Selection was not actually implemented due to untestability on the dynamometer, the Final Emission Test Selection field shall be populated with either 2 or 4. Otherwise the Current Emission Test Selection must have been performed. Thus, Final Emission Test Selection field shall be populated with the same value as the Current Emission Test Selection.

The final inspection results shall be determined as follows:

Final Emission Test Selection	Overall Emission	Functional	Safety	#
TSI and Safety	P	P	P	2
Transient and Safety	P	P	P	3
Non-Loaded Diesel and Safety	P	N/A	P	4
Loaded Diesel and Safety	P	N/A	P	5

Note that until the diesel program is implemented, vehicles having fuel type = D (diesel) will receive a 1-year sticker and one-year sticker fee. The tailpipe test is exempt – overall pass is determined by safety result only. Current and Final Emission Test Selection fields shall be set to 4.

a   *If Current Year minus Model Year is greater than 25 years, the emission test P/F result shall NOT affect the overall P/F result.*

b   *If all required entries contain P entries, then a P shall be entered into the* Overall Test Result *field of the test record.*

c   *If any of the fields indicated contain an F, then F shall be entered in the* Overall Test Result *field. The vehicle shall fail the inspection.*

d   *Once the Pass/Fail determination has been made, the test cannot be aborted by the inspector. The test data cannot be changed.*

e   *When the pass/fail determination has been made, the RI2000 shall record the time to the* Test End Time *field of the test record.*

f   *If the manufacturer's new tamper since last test flag is set, the Tamper Since Last Test field in TEST.DAT shall be set to "Y", and the new tamper detected since last test flag shall be cleared.*

     g   *If Prevented Dyno Test (based on Safety dyno prevention) is "y", then an F shall be entered into the Overall Test Result field of the test record.*

     h   *If the Official Result Based on OBD (NETWORK.DAT) is "N", OBDII results shall not affect the Overall Test Result.*

     i   *If the Official Result Based on MIL (NETWORK.DAT) is "N", MIL results shall not affect the Overall Test Result.*

3.6.24 Sticker

Serialized stickers having a preprinted, one-dimensional bar code and a numeric serial number will be printed for all vehicles.   The preprinted sticker bar code will carry the encoded serial number of the sticker. It will also carry a crosscheck validation code. The encoded validation code will NOT be numerically printed on the sticker. However, the encoded serial number will be numerically printed on the sticker.

The RI2000 shall utilize the lowest sticker number contained in the inventory. When a sticker is used, it shall be removed from STICKER.DAT by incrementing the StartingSerial field by 1. When a sticker is going to used and StartingSerial = EndingSerial, the record should be purged from the file. The analyzer shall be locked out till a new batch (range) is loaded.

The RI2000 shall print a sticker per guidelines from Keating..

The workstation software will prompt the inspector to read and key in the serial number of each sticker immediately after it is issued. When a sticker is issued, the workstation will record the sticker serial number and validation code and link them to a test record for transmission to the host.

Note that until the diesel program is implemented, vehicles having fuel type = D (diesel) will receive a 1-year sticker and one-year sticker fee. The tailpipe test is exempt – overall pass is determined by safety result only. Current and Final Emission Test Selection fields shall be set to 4.

DISPLAY PROMPT:

SCAN THE BAR CODE ON THE NEW INSPECTION STICKER.

ONLY IF THE BAR-CODE READER WILL NOT PROPERLY SCAN THE STICKER, ENTER NUMBER MANUALLY.

REMOVE OLD STICKER, IF APPLICABLE.

IF THE VEHICLE DOES NOT HAVE AN INNER-SHIELD WINDSHIELD, PLACE NEW STICKER ON THE VEHICLE WINDSHIELD. OTHERWISE, HAND THE STICKER TO THE

VEHICLE OWNER.

a   Programming Criteria:

1   If the inspector scans the STICKER (scanned entries cannot be edited), the RI2000 shall proceed. The RI2000 shall allow manual entry of the sticker number.

2   The sticker contains a bar code using either code 39 or 128 symbologies. The bar-code scanner must be able to automatically discriminate between the symbologies to ensure that the current information shall be automatically read.

3   The RI2000 shall automatically store the source of the sticker. For *Sticker number input source* field:

S = Bar code on sticker

M = Manual entry

The RI2000 shall write the input source in the New *Sticker number input source* field of the test record.

4   If the "*Previous Emission Repair Time Delay Waiver*" field in TEST.DAT contains a "Y", "PTW" shall be printed on the sticker to indicate this, per Keating specifications.

5   The input shall allow up to a 9 digit numeric entry. If invalid entry, or entry is not within loaded range,

DISPLAY PROMPT:

INVALID ENTRY - - TRY AGAIN.

6   If the sticker sequence is incorrect, the operator shall be prompted to verify input.

7   If there is still a discrepancy, the RI2000 shall inquire the status of the missing stickers. A range of or an individual sticker(s) may be Void, Missing, Stolen, or Damaged. The RI2000 shall prompt the inspector for only the last number of a range. It shall then apply the status indicated by the inspector to the range of missing stickers. The range is from the expected sticker number through the number entered by the inspector (entered sticker must be a valid number within the range of those left on the analyzer). Each sticker Void, Missing, Stolen, or Damaged shall result in a record in the STCKVOID.DAT file. If the last sticker of a range is missing, void, stolen, or damaged, the RI2000 shall abort the inspection. Update incomplete file.

8   Under the TRAINING mode, even if the vehicle passes the Inspection, the RI2000 shall not issue a sticker.

9   The New Sticker Number and Crosscheck Validation Code fields shall be written to the TEST.DAT file.

10   The number of remaining inspection stickers ̶o̶f̶ ̶e̶a̶c̶h̶ ̶t̶y̶p̶e̶ shall be displayed each time a sticker is used.

11   Prior to MMDDYYYY (Begin Biennial Inspection field in NETWORK.DAT), for all regular inspections and all waivers, the following logic shall be applied:

     i   If the last VIN character is an odd digit, the sticker shall expire 1 year from issue date.

     ii   If the last VIN character is a non-numeric character or an even digit, the sticker shall expire 2 years from issue date.

12   On or after MMDDYYYY (Begin Biennial Inspection field in NETWORK.DAT), for all regular inspections and all waivers, the sticker shall expire 2 years from issue date.

13   Test type or waiver type will be indicated on the sticker.

3.6.25 Test Payment and Test Authorization

The following table indicates which transactions cause a Test Authorization to be used from the inventory and which transactions cause a fee to be paid by the vehicle owner:

Transaction Type	#	Payment Required	Test Authorization Used
All 2-year inspections except free retests	1	Y	Y
Free Retests	2	N	N
All Waivers	3	N	N
Challenge Test	4	N	N
All Program startup 1-year inspections except free retests	5	Y	Y

Note that until the diesel program is implemented, vehicles having fuel type = D (diesel) will receive a 1-year sticker and one-year sticker fee. The tailpipe test is exempt – overall pass is determined by safety result only. Current and Final Emission Test Selection fields shall be set to 4.

The Transaction Type Number shall be determined by and stored by the analyzer to the TEST.DAT or WAIVER.DAT (depending on transaction).

Transaction type 1 vs. 5 is determined as follows:

1   Prior to MMDDYYYY (Begin Biennial Inspection field in NETWORK.DAT), the following logic shall be applied:

    i   If the last VIN character is an odd digit, the one-year inspection fee is charged (*One Year Test Fee* in NETWORK.DAT), and the authorization shall be issued from a type 1 inventory batch (*Inventory Type* = 1 in INVENTRY.DAT).

    ii   If the last VIN character is a non-numeric character or an even digit, the two-year inspection fee is charged (Two *Year Test Fee* in NETWORK.DAT), and the authorization shall be issued from a type 2 inventory batch (*Inventory Type* = 2 in INVENTRY.DAT).

2   On or after MMDDYYYY (Begin Biennial Inspection field in NETWORK.DAT), for all vehicles, the two-year inspection fee is charged, and the authorization shall be issued from a type 2 inventory batch (*Inventory Type* = 2 in INVENTRY.DAT).

Transaction type 2 is determined as follows: If the test counter is even (2, 4, 6, …) and the previous test was performed at the same station within the last 30 days (<= 30 days ago), the retest is free.

Transaction type 3 is used for all types of waiver.

Transaction type 4 is used for all challenge tests.

For waivers, the previous test authorization number will be received in the Waiver record from the HCS.

3.6.26 Display of Final Emission Inspection Test Results

The RI2000 shall store the final, complete test record to TEST.DAT prior to the display of test results. The TEST.DAT shall be transmitted to the HCS during the next HCS contact (except Network Diagnostic).   The RI2000 shall display the final inspection test results. As a minimum, the emission standards and the words PASS or FAIL shall be written beside each inspection result except for CO_2 and O_2.

3.6.27 Vehicle Inspection Report (VIR)

The Vehicle Inspection Report (VIR) printer shall:

1   Print VIRs for passing, failing, and waived vehicles.

2   Print the Diagnostic Trace Report and Statistical Diagnostic Text Messages for failing vehicles. Appendix II contains an example of the reports.

3   Print the blank Repair Report Form for failing vehicles.

4   Indicate whether the test was paid or not paid.

5   Use the AVGCYCLE.DAT file to determine the nominal test cycle emissions, for passing vehicle during the transient drive cycles A-D, on the VIR. This is not second by second data. This is the average grams/mile emitted by passing vehicles by transient cycle type. For a failing vehicle, these values will be printed next to the measured emissions for the vehicle.

6   Following each failed vehicle inspection the workstation must support receipt and printout of a listing of nearby repair shops. All Rhode Island repair shops will be listed in the STATLIST.DAT file. The analyzer shall prompt the inspector for entry of a zip code for looking up the closest repair shops. The analyzer shall allow a 5-digit zip code entry. The workstation must print the list, of all shops in STATLIST.DAT where the first 5 numbers of the zip code match that entered by the inspector, at the conclusion of failed vehicle inspections. *(Note: This requirement for RI2000 will be deferred until 03/01/2000.)*

7   For retests, print only section results, and dashes for detailed sections of the VIR which passed during a previous inspection and were not tested during this inspection.

All printouts will be created, on demand, from blank stock. The workstation printer shall print the test authorization number on each VIR.

a   *Appendix II*

Appendix II displays the content and format of the VIR, Diagnostic Trace Report, and Diagnostic Text Report. The VIR contains information blocks for all emissions and safety inspection results as well as vehicle identification information and motorist explanations. In the event of a safety-only test, the emissions blocks would be printed with an "NA" for not applicable.

b   *Diagnostic Trace Report (AVGSBS.DAT)*

For transient emission failure, the RI2000 shall print average second by second emissions results of passing vehicles along with the test vehicle results in a graphical format. Appendix II contains an example of the format. The average second by second data for all continuants will be transmitted in the AVGSBS.DAT file. This file shall be indexed by the AVGSBS Locator, fuel type and test cycle.

AVGSBS Update

During an AVGSBS Update, records will be replaced or appended as necessary, based on AVGSBS Locator(s) and Transient Drive Cycle Type. For example, during an AVGSBS update, for AVGSBS Locator number

20,000 and Transient Drive Cycle Type A, all local AVGSBS records with Locator number 20,000 and Transient Drive Cycle Type A will be replaced with a new set of records.

3.7 Repair-only Software Functions

The REPAIR.DAT file will be utilized. The Repair-Only Software function shall display the following options:

~~1.1.1~~3.7.1   *Recall Repair Records*

(Note: This requirement for RI2000 will be deferred until 03/01/2000.)

When this menu item is selected, the RI2000 shall prompt the inspector to enter the inspector license number and access code per the Inspector License Number Entry and Inspector Access Code Entry sections. Next, the RI2000 will prompt the inspector for the vehicle information as described in the Initial Vehicle Data Entry section. Upon transmission to the HCS, if records are found, the HCS will transmit up to 10 of the most recent repair records. The software shall allow the inspector to only view and/or print a user-selectable number of records.

~~1.1.2~~3.7.2   *Create New Repair Records*

(Note: This requirement for RI2000 will be deferred until 03/01/2000.)

When this menu item is selected, the RI2000 shall prompt the inspector to enter the inspector license number and access code per the Inspector License Number Entry and Inspector Access Code Entry sections. Next, the RI2000 will prompt the inspector for the vehicle information as described in the Initial Vehicle Data Entry section. The RI2000 shall initiate repair information entry per the following sections:

a   *Repairs Performed Before Test Section*

b   *Repair Action Categories Section*

c   *Repair Cost Information Section*

The repairs entered will be transmitted by the RI2000 to the HCS on the next HCS contact.

~~1.1.3~~3.7.3   *Obtain Repair Station List*

(Note: This requirement for RI2000 will be deferred until 03/01/2000.)

~~3.8~~The workstation must support receipt and printout of a listing of nearby repair shops. All Rhode Island repair shops will be listed in the STATLIST.DAT file. The analyzer shall prompt the inspector for entry of a zip code for looking up the closest repair shops. The analyzer shall allow a 5-digit zip code entry. The workstation must print the list, of all shops in STATLIST.DAT where the first 5 numbers of the zip code match that entered by the inspector. Manual Testing Modes

Select the appropriate fuel type in accordance with Vehicle Fuel Type Code. After the inspector has selected the fuel type, the RI2000 shall display the following menu items:

DISPLAY PROMPT:

ENTER CHOICE FOR MANUAL MODE TESTING:

1) NO-LOAD EMISSIONS MEASUREMENT

2) INSPECTOR SELECTED STEADY LOAD

3) STRUCTURED TEST DRIVE

4) FREE-FORM TEST DRIVE

5) FUEL CAP TEST

The operator shall have the ability to display the analytical results in either grams/mile, concentration, or Opacity (opacity is required only for No-Load Emissions Measurement and Inspector Selected Steady Load). At the conclusion of any of the above modes, the software shall, if the inspector chooses, be able to display or print a time-aligned second-by-second emissions and wheel speed (if applicable) plot for each gas (HC, CO, NO, O_2 and CO_2) for up to the last 240 seconds of any of the manual test modes. The gas values shall default to dilution corrected readings for the non-loaded test mode and as an option may be set to uncorrected for dilution as toggled by the inspector. The RI2000 shall display the emission readings of (HC, CO, NO, O_2 and CO_2). however, the manufacturer may provide an option to toggle off the display.   The rules for applying the DCF during the non-loaded manual mode shall be the same as the inspection mode.

Each of the above tests, aside from the No-Load Emissions Measurement, must be preceded by the RI2000 manufacturer's recommended pretest procedures.

~~1.1.1~~3.7.4   *No-Load Emissions Measurement*

When the operator selects the No-Load Emissions Measurement, the analyzer shall start sampling the above gases (except for NO). The RI2000 shall display these gas values along with the engine speed on the screen until the operator leaves the No-Load Emissions Measurement.

~~1.1.2~~3.7.5   *Inspector Selected Steady Load*

When the operator selects the Inspector Selected Steady Load, the driver shall be prompted to enter a horsepower load for the dynamometer to simulate. The RI2000 shall simulate tire losses, and the inspector shall be warned accordingly. However, the manufacturer may provide an option to toggle off the tire losses and warning message. This horsepower should be accurate and should not exceed safe limits established by the RI2000 manufacturer. The dynamometer shall smoothly apply the load. The

analyzer shall start sampling and the following values shall be displayed on the screen: gas readings for HC, CO, NO, O2 and CO2, opacity concentration for diesel, engine speed, wheel speed, and a reference time clock (displaying seconds).

~~1.1.3~~3.7.6 Structured Transient Test Drive

To assist in the repair of vehicles, the RI2000 must be capable of providing a repeatable test drive for the vehicle to follow Rhode Island simulation traces. As with the other diagnostic tests, the vehicle information must be known prior to conducting structured test drive. If the information for the vehicle has not been entered already, the software must prompt the inspector to enter all vehicle data required to correctly access the VLT. This information will be used to determine the appropriate vehicle loading from the VLT. The load shall be applied according to the requirements in the Dynamometer & Auxiliary Equipment Specifications section.

Once the vehicle information is entered, the software shall display HC, CO, NO, O_2 and CO_2 gases, engine speed, and wheel speed while the gas analyzer starts taking samples. The test shall start once the operator presses START.

~~1.1.4~~3.7.7 Free-Form Test Drive

To assist in the repair of vehicles, the RI2000 must be capable of providing a free-form test drive. This will allow the vehicle to be test driven on the dynamometer as it would be test driven on the actual road. As with the transient Diagnostic Test, the vehicle information must be known prior to conducting the free-form test drive. If the information for the vehicle has not been entered already, the software must prompt the inspector to enter all vehicle data required to correctly access the VLT. This information will be used to determine the appropriate vehicle loading from the VLT. The load shall be applied according to the requirements in the Dynamometer & Auxiliary Equipment Specifications section.

Once the vehicle information is entered, the software shall display HC, CO, NO, O2 and CO2 gases, engine speed, and wheel speed while the gas analyzer starts taking samples. The test shall start once the operator presses START.

~~1.1.5~~3.7.8 Fuel Cap Test

The system shall allow the operator to perform a diagnostic gas cap test. The results will not be transmitted to the HCS.

~~3.9~~3.8 RI2000 Calibration Menu

The calibration frequencies passed from the HCS in the NETWORK.DAT file shall be in hours (XXX). When the operator selects the RI2000 CALIBRATION MENU, the RI2000 shall display the following menu items:

DISPLAY PROMPT:

ENTER CHOICE:

1) **CALIBRATE ALL**

2) **ANALYZER SAMPLE SYSTEM LEAK CHECK**

3) **ANALYZER GAS CALIBRATION**

4) **DYNAMOMETER CALIBRATION**

5) **FUEL CAP TESTER CALIBRATION**

6) **FLOPPY DRIVE AND FLOPPY DISK CHECK**

7) **OPACITY METER CALIBRATION**

8) **VORTEX STRUT CHECK**

9) **RAW TRANSPORT TIME CHECK**

The procedures shall be user-friendly and shall prompt the operator through every step needed to properly perform the required calibration/system check (including, for example, when to turn the gas cylinder valve on and off). Results of all calibrations and checks shall be displayed and recorded in the calibration record. All cylinder bar code data shall be stored in the calibration record. Only applicable choices shall be displayed based on RI2000 configuration.

When a calibration is selected, license and access code entries are to be made (per the sections for Inspector, QA/Staff, and FSR license and access code entries), and the following fields are to be stored in the calibration record: Calibration Record Number, RI2000 Number, Calibration Date, Calibration Type Code, Inspector License Number, Calibration Start Time, Calibration End Time, and all available Serial Number fields.

If an inspection is initiated, and the dynamometer calibration has failed, the RI2000 shall display the following prompt:

DISPLAY PROMPT:

THE DYNAMOMETER HAS FAILED CALIBRATION. PRESS *(function key)* **TO CONTINUE WITH TWO-SPEED IDLE TEST OR [ESC] TO ABORT.**

If the RI2000 fails any portion of the calibration, a message shall be displayed indicating the failure and suggesting possible operator-fixable causes for the failure; e.g.,

DISPLAY PROMPT:

CHECK GAS CYLINDERS SHUT/EMPTY/CONNECTED TO

**WRONG PORTS. TRY AGAIN. IF NONE OF THESE, CALL
SERVICE.**

a   Calibrate All

The system shall allow the operator to perform any and all calibration
consecutively as a result of picks made in this menu. The following tests
shall be displayed along with calibration due date:

DISPLAY PROMPT:

ANALYZER SAMPLE SYSTEM LEAK CHECK

ANALYZER GAS CALIBRATION

DYNAMOMETER CALIBRATION

FUEL CAP TESTER CALIBRATION

FLOPPY DRIVE AND FLOPPY DISK CHECK

OPACITY METER CALIBRATION

VORTEX STRUT CHECK

RAW TRANSPORT TIME CHECK

The selections shall perform automatically, in sequence, all the other items
in the Calibration Menu, prompting the operator to perform tasks as
required. The calibrations and checks shall be performed in the same
order as the Calibration Menu list. The details will be delineated in Items b)
through i), below.

b   Analyzer Sample System Leak Check

The calibration frequency will be configurable from the HCS. Selection of
this item shall bring up a set of leak check procedures. The procedures
shall be user friendly and shall indicate every step needed to properly
perform a leak check (including when it is necessary to turn the gas
cylinder valve on and off). Procedures shall be approved by the Program
Administrator. Results of the leak check shall be displayed and recorded in
the Leak Check PF field of CAL.DAT. If the RI2000 fails the leak check,
the unit shall be "locked out" (prevented from testing) and a message shall
be displayed on the screen indicating that and instructing the operator how
to correct the failure or to call for repairs.

c   Analyzer Gas Calibration

The calibration frequency will be configurable from the HCS.

If the RI2000 has not passed an Analyzer Sample System Leak Check
within one hour prior to initiating the gas calibration, the RI2000 shall initiate
the Leak Check sequence prior to performing the Analyzer Gas Calibration.

The last entries for the gas bottles values shall become the default values

for the manual entry described below. Any new entry, scanned or manually entered, shall serve as default gas bottles values for the next calibration. When this menu item is selected, the RI2000 shall disable the Dilution Correction Factor (DCF) and shall display the following prompt:

DISPLAY PROMPT:

SCAN THE HIGH RANGE CYLINDER'S THREE BAR CODES IN SEQUENCE (1, THEN 2, THEN 3), OR PRESS [FUNCTION KEY] FOR MANUAL ENTRY.

1   If the operator presses the [*function key*], the RI2000 shall display a manual entry Gas Cylinder Data Screen, prompting the operator to enter the information manually via the keyboard.

- RI Label Number
- Gas Blend Code
- HC Cyl. Value, ppm
- CO Cyl. Value, %
- CO_2 Cyl. Value, %
- NO Cyl. Value, ppm
- O_2 Cyl. Value, %
- Cylinder Lot Number
- Cylinder Expiration Date

The software shall ensure that there are no entries that are more than $\pm 2.1\%$ different that the required bottle value. In another words, the RI2000 shall not accept any entry that is outside of the allowed blend tolerance specification.

After the operator has successfully scanned the bar codes on the high range cylinder, or entered the required data manually, the software shall prompt him to

DISPLAY PROMPT:

SCAN THE LOW RANGE CYLINDER'S THREE BAR CODES IN SEQUENCE (1, THEN 2, THEN 3), OR PRESS [FUNCTION KEY] FOR MANUAL ENTRY.

The software shall follow the same procedure as in Step 1.i above.

After the operator has successfully scanned the bar codes on the low range cylinder, or entered the required data manually, the software begin the calibration routine, displaying prompts

for operator actions and inputs, and the status of the calibration procedure as it progresses.

DISPLAY PROMPT:

ENSURE ZERO AIR GENERATOR IS OPERATING.

PRESS [function key] TO CONTINUE.

2   After the operator presses the function key, the software shall cause zero air to flow through the analyzer. The RI2000 manufacturer shall determine how long the flow must be maintained. The RI2000 shall adjust all channels except O_2 to zero. The O_2 channel shall be calibrated to 20.9%.

3   The software shall then cause High Range RI2000 calibration gas to flow through the analyzer. The response time check in Step iii below shall be performed at this point. Each channel shall be adjusted to the center of its tolerance range, except that O_2 shall have its zero reading adjusted to the center of its tolerance range.

4   During the gas calibration procedure, analyzer/sensor response times for the CO, NO and O_2 channels shall be checked. The RI2000 computer shall keep track of the analyzer/sensor responses to the introduction of the high range calibration gas, shall calculate the time required to reach T_{90} (see §2.4), and shall compare it to the values stored in memory when the optical bench or sensor was manufactured or first installed. If the difference between the values exceeds one (1) second, a message shall be displayed on the RI2000 monitor.

DISPLAY PROMPT:

ANALYZER RISE TIME TOO SLOW. CALL FOR SERVICE. PRESS [*function key*] **TO CONTINUE.**

If the difference between the values (except for O_2) exceeds two (2) seconds, the RI2000 shall fail the gas calibration, prevent any inspections from being performed, and a suitable message displayed.

DISPLAY PROMPT:

FAILED GAS CALIBRATION. ANALYZER RISE TIME TOO SLOW. CALL FOR SERVICE. PRESS [*function key*] **TO CONTINUE.**

Similarly, the RI2000 computer shall keep track of the analyzer/sensor responses to the purging of the high range calibration gas, shall calculate the time required to reach T10 (see §2.4, and shall compare it to the values stored in memory when manufactured or first installed. If the difference between the values exceeds one (1) second, a message shall be displayed on the RI2000 monitor.

DISPLAY PROMPT:

ANALYZER FALL TIME TOO SLOW. CALL FOR SERVICE. PRESS [*function key*] **TO CONTINUE.**

If the difference between the values (except for O2) exceeds two (2) seconds, the RI2000 shall fail the gas calibration, store any results to the calibration record, prevent any inspections from being performed, and a suitable message displayed.

DISPLAY PROMPT:

FAILED GAS CALIBRATION. ANALYZER FALL TIME TOO SLOW. CALL FOR SERVICE. PRESS [*function key*] **TO CONTINUE.**

5   If the analyzer passed the response time test, the software shall then cause Low Range RI2000 calibration gas to flow through the analyzer. Each channel shall be checked, but NOT adjusted, to determine that each channel is still within the accuracy requirements listed in the Exhaust Gas Analysis and Other Hardware Modifications section.

Acceptance Criteria: (1) If Steps i, ii, iii, and iv, above are all successfully completed, the software shall display the prompt

DISPLAY PROMPT:

PASSED GAS CALIBRATION. PRESS [*function key*] **TO CONTINUE.**

When the operator presses the [function key], the software shall return to the calibration menu. If this calibrate all, the RI2000 shall proceed to the leak check procedure. (2) If any step is not successfully completed, the software shall display the prompt

DISPLAY PROMPT:

FAILED GAS CALIBRATION. TRY AGAIN? (YES/NO)

If the operator enters YES, the software shall repeat the calibration procedure from Step iii one more time. If the operator enters NO, the software shall return to the calibration menu, shall store the result in Calibration Data file and shall prevent an inspection from being performed.

6   End of calibration:

DISPLAY PROMPT:

CHECK ZERO AIR GENERATOR FILTER BOWLS AND DRAIN WATER.

INSPECT AND CHANGE ZERO AIR GENERATOR FILTERS, IF REQUIRED.

PRESS [function key] TO CONTINUE.

7   Summary:

To summarize the analyzer calibration sequence.

i   The RI2000 flows zero air; the HC, CO, CO_2 & NO channels are zeroed; the O_2 channel is set to 20.9%.

ii   The RI2000 flows high range gas; the RI2000 measures response times to T_{90} for CO & NO and T_{10} for O2 and compares to response times when new; the HC, CO, CO_2 & NO channels are calibrated; the O_2 channel is zeroed.

iii   The RI2000 flows zero air; the RI2000 measures response times to T_{10} for CO & NO — T_{90} for O_2 — and compares to response times when new.

iv   The RI2000 flows low-range gas and checks the analyzer readings to ensure that the accuracy requirements of this specification are met (NO calibration adjustments made at low range).

v   The RI2000 makes the analyzer calibration pass/fail determination, stores the result in the Bench Calibration Result field of CAL.DAT, and purges the bench and goes on to the next step.

d   Dynamometer Calibration

The calibration frequency will be configurable from the HCS. The dynamometer shall be calibrated using the following calibration procedures

described below. If the dynamometer fails the calibration, the RI2000 shall not be locked out of two-speed idle testing.

1   **Coast-down Check:** Whenever the dynamometer is due for dynamometer coast-down check, the RI2000 shall perform the coast-down check in accordance with the Dynamometer & Auxiliary Equipment Specifications section. The RI2000 shall display the following message:

DISPLAY PROMPT:

DYNAMOMETER COAST-DOWN CHECK IS REQUIRED
Programming Criteria:

i   The RI2000 shall provide sufficient information to instruct the operator to perform the dynamometer coast-down check. The operator shall be required to press a function key to start this check procedure and the RI2000 shall display the following message:

DISPLAY PROMPT:

DYNAMOMETER COAST-DOWN CHECK IN PROGRESS.
ii   Upon completion of the dynamometer coast-down check, the RI2000 shall store in the calibration record file the coast-down times.

a. If the dynamometer coast-down times are within the limits, then the dynamometer passes the coast-down check and the RI2000 shall display the following message:

DISPLAY PROMPT:

DYNAMOMETER CALIBRATION COMPLETE.
b. If the dynamometer coast-down times are not within the limits, the RI2000 shall be locked out of inspection for DYNAMOMETER COAST-DOWN FAILURE.

DISPLAY PROMPT:

DYNO COAST-DOWN FAILURE -- PERFORM PARASITIC LOSS DETERMINATION
iii   Parasitic Loss Determination: Perform the Parasitic Loss Determination according to the procedures in the Dynamometer & Auxiliary Equipment Specifications section. The RI2000 shall store parasitic losses

measured in horsepower in the calibration record.

a) If the dynamometer parasitic losses are within the limits, then perform another coast-down check using the new parasitic loss values.

DISPLAY PROMPT:

DYNO PARASITIC LOSSES RECALIBRATED -- PERFORM COAST DOWN CHECK

1. If the coast-down times are within manufacturer required specifications, the dynamometer calibration is complete.

DISPLAY PROMPT:

DYNAMOMETER CALIBRATION COMPLETE

2. If the coast-down times are not within manufacturer required specifications, the dynamometer shall be locked out of inspection for DYNAMOMETER LOAD CELL CALIBRATION FAILURE.

DISPLAY PROMPT:

DYNAMOMETER LOAD CELL CALIBRATION FAILURE -- PERFORM DEAD WEIGHT CALIBRATION

b) If the dynamometer parasitic losses are not within the manufacturer's allowable limits, then the RI2000 shall be locked out of inspection for DYNAMOMETER PARASITIC LOSSES FAILURE.

DISPLAY PROMPT:

DYNO PARASITIC LOSS FAILURE -- CALL FOR SERVICE

iv   If a dynamometer's parasitic losses fall within the manufacturer's recommended limits but the dynamometer cannot pass the coast-down test, perform the dead weight calibration according to the manufacturer's recommended procedures followed by another coast-down test. Record the coast-down values and the dead weight test results in the calibration record.

a) If the load cell will not come to within manufacturer's recommended specifications, the RI2000 shall be locked out of inspection for

DYNAMOMETER LOAD CELL FAILURE.

DISPLAY PROMPT:

DYNO LOAD CELL FAILURE -- CALL FOR SERVICE.
> b) If the coast-down times are still not within the limits after the load cell calibration, the RI2000 shall be locked out of inspection for DYNO CALIBRATION FAILURE.

DISPLAY PROMPT:

DYNO CALIBRATION FAILURE -- CALL FOR SERVICE
> c) If the parasitic losses and the coast-down times are within the allowable limits, the dynamometer may be used to perform inspections.

DISPLAY PROMPT:

DYNAMOMETER CALIBRATION COMPLETE
> d) Store the result in the Dyno Coast Down Check field of CAL.DAT.

    e   *Fuel Cap Tester Calibration*

The calibration frequency will be configurable from the HCS.. The RI2000 shall display the following prompts.

    1   Pass Cap

DISPLAY PROMPT:

TIGHTLY INSTALL THE "PASS CALIBRATION CAP" ON THE FUEL CAP TESTER AND PRESSURIZE THE SYSTEM AND PRESS THE START TEST BUTTON.
> i   The tester shall send a pass/fail to the RI2000. If a pass is sent to the RI2000, the RI2000 shall continue on with the fail cap test **(2)**. If a fail is sent to the RI2000, the RI2000 shall display the following prompt.

DISPLAY PROMPT:

THE "PASS CALIBRATION CAP" HAS FAILED. REMOVE THE "PASS CALIBRATION CAP" AND CHECK FOR PROPER SEAL. BE SURE THE CALIBRATION CAP IS TIGHTLY INSTALLED.
> ii   The tester shall send a pass/fail to the RI2000. If a pass is sent to the RI2000, the RI2000 shall continue

on with the fail cap test **(2)**. If a fail is sent again, the RI2000 shall display the following prompt.

DISPLAY PROMPT:

THE FUEL CAP TEST SYSTEM IS NOT CALIBRATED OR IS MALFUNCTIONING. SET FUEL CAP TEST SYSTEM CALIBRATION (<u>ONLY</u> IF SYSTEM IS DESIGNED FOR RECALIBRATION) OR CALL FOR SERVICE.

2   Fail Cap

DISPLAY PROMPT:

TIGHTLY INSTALL THE "FAIL CALIBRATION CAP" ON THE FUEL CAP TESTER AND PRESSURIZE THE SYSTEM AND PRESS THE START TEST BUTTON.

    i   The tester shall send a pass/fail to the RI2000. If a fail is sent to the RI2000, the calibration shall end at this point.

    ii   If a pass is sent to the RI2000, the RI2000 shall display the following prompt.

DISPLAY PROMPT:

THE FUEL CAP TESTER HAS FAILED THE CALIBRATION CHECK. THE FUEL CAP TEST SYSTEM IS NOT CALIBRATED OR IS MALFUNCTIONING.
    If the system is designed for recalibration, the following prompt shall be displayed:

DISPLAY PROMPT:

SET THE FUEL CAP TEST SYSTEM CALIBRATION.
    If the system is NOT designed for recalibration, continue with the following prompt: **CALL FOR SERVICE.** A lockout shall be set if the fuel cap tester cannot be recalibrated or fails after recalibration.

    NOTE: The manufacturer may modify the above procedure upon approval by RI.

3   Overall result shall be stored in the Gas Cap Calibration PF field in CAL.DAT.

    f   Floppy Disk Check

The calibration frequency will be configurable from the HCS. The State-secured floppy disk shall be checked for surface structure, directory structure, file system and file allocation table errors. The RI2000 shall display the following prompt.

DISPLAY PROMPT:

PRESS ENTER TO START FLOPPY DISK CHECK.

If no errors are found, the following prompt shall be displayed.

DISPLAY PROMPT:

FLOPPY DRIVE CHECK PASSED

If an error is found and the error can not be repaired, a lockout shall be set and the following prompt shall be displayed.

DISPLAY PROMPT:

FLOPPY DRIVE ERROR. CALL FOR SERVICE.

NOTE: All floppy disk surface errors require the above prompt. Software repairs are not usually adequate and these errors are a sign of disk deterioration.

Result shall be stored in Floppy Disk Check PF field of CAL.DAT.

g   Opacity Meter Calibration

The calibration frequency will be configurable from the HCS. The RI2000 shall determine pass/fail result during calibration check, and the result shall be stored in the Diesel Opacity Calibration PF field of CAL.DAT. The RI2000 manufacturer shall recommend a calibration check procedure for evaluation by the Program Administrator on proposed opacity meter.

The opacity meter calibration option shall appear only if the RI2000 is equipped with an opacity meter and the CONFIG.DAT file indicates the RI2000 system is allocated to perform Diesel testing.

h   Vortex Strut Check

The check frequency will be configurable from the HCS.

DISPLAY PROMPT:

REMOVE STRUT AND CLEAN

IS THE STRUT CLEAN (Y/N).

Programming Criteria

1   If N, the check shall fail.

2   If Y, the check shall pass.

3   Result shall be stored in Strut Clean field of CAL.DAT.

i   *RAW TRANSPORT TIME CHECK*

The frequency of the Raw Transport Time Check shall be determined by the Raw Transport Time Check Frequency field of the NETWORK.DAT file. The result shall be stored in the Transport Check PF field of CAL.DAT. The RI2000 shall be zeroed and a hang-up check shall be performed. The software shall prompt the operator to:

DISPLAY PROMPT:

INSERT THE SAMPLE PROBE INTO THE TAILPIPE

Programming Criteria

1   The sample system shall be in back purge mode when the probe is initially inserted in the vehicle.

2   The time required to reach YY.YY % CO_2 (passed in the Raw Transport Check % field in the NETWORK.DAT – default =00.25%) shall be measured when the analyzer is switched into sample mode.

3   If this time differs more than X second (passed in the Raw Transport Check Time field in the NETWORK.DAT – default =1) from the time measured in Raw Transport Determination, the RI2000 shall be locked out from testing.

4   If the response check detects that the probe was not in the car or if it fails, the test shall be repeated.

5   Operator shall be asked to check and if applicable replace external filters and damage to probe

DISPLAY PROMPT:

CHECK AND IF APPLICABLE REPLACE EXTERNAL FILTERS

6   Operator shall be allowed to rerun the test.

7   After three tries, the system shall be locked out from testing. A service call must be made

DISPLAY PROMPT:

RAW TRANSPORT TIME CHECK FAILURE. CALL SERVICE

Assuming the response time check passes, the RI2000 lockout shall be automatically cleared.

3.10̶3.9 Status Page

Selection of this item will display a status screen containing all items found in the

RI2000 Lockout Reason section and the following information:

- RI2000 number
- Span gas cylinder values
- Date and time of last calibration for all required tests in the RI2000 Calibration Menu section.
- Date RI2000 was last serviced
- Time and date
- Active software version number
- Date and time of last network access
- Number of inspections and number of days since last network access
- Ambient Temperature
- Barometric Pressure
- Relative Humidity
- VMAS™ Temperature
- VMAS™ Pressure (ACFM)

(Note that VMAS items are not required on the RI2000 Status Page until 03/01/2000.)

~~3.11~~3.10   Network Communications Diagnostics

This item shall be used to diagnose communications-related problems. The following diagnostic tests shall be provided:

a   *Dial Tone Check*

The RI2000 shall have the capability of performing a dial tone check. When selected, the RI2000 shall check for the presence of a dial tone.

If a dial tone is not present, the RI2000 shall display the following message:

> **DISPLAY PROMPT:**

> **DIAL TONE CHECK FAILED**

> **VERIFY THAT DEDICATED PHONE LINE IS PLUGGED IN AND RETRY**

If a dial tone is present, the RI2000 shall display the following message:

> **DISPLAY PROMPT:**

> **DIAL TONE CHECK PASSED**

If after entry, the dial tone is not present, display the following message:

DISPLAY PROMPT:

DIAL TONE CHECK FAILED

b   Modem Serial Port Diagnostics

Modem serial port diagnostics shall be provided by the RI2000 manufacturer, pursuant to manufacturer-specific hardware configurations.

It is the responsibility of the RI2000 manufacturer to work with the HCS contractor to ensure that the modem strings are set up automatically and correctly.

c   Network Diagnostics

The RI2000 shall provide the data needed to conduct NETWORK DIAGNOSTICS. The data file Network DIAGNOSTIC TRANSMIT RECORD shall be transmitted to the HCS and the data file NETWORK DIAGNOSTIC RECEIVE RECORD shall be sent back to the RI2000 from the HCS, as defined in the communication protocol. They should be identical upon completion of the network diagnostics routine for this test to pass. The RI2000 shall display the following message:

DISPLAY PROMPT:

TRANSMITTING DATA, PLEASE WAIT.

1   Programming Criteria:

   i   If, upon completion of network access, the data transmitted by the RI2000 to the HCS is the same as the data received by the RI2000 from the HCS, then the RI2000 shall display the following message:

DISPLAY PROMPT:

NETWORK COMMUNICATIONS PASSED.

   ii   If, upon completion of network access, the data transmitted by the RI2000 to the HCS is not the same as the data received by the RI2000 from the HCS, then the RI2000 shall display the following message:

DISPLAY PROMPT:

NETWORK COMMUNICATIONS FAILED.

   iii   If network communications access is not achieved, the RI2000 shall display the following message:

DISPLAY PROMPT:

CANNOT ACCESS NETWORK.

d   *Remote Dial-In Check*

The RI2000 shall be capable of responding to a modem tone check. The RI2000 can be placed in mode to meet this requirement (i.e. this occurs only in this designated menu selection).

3.123.11   Inspector Training

Prompts shall be provided to allow the inspector to perform a practice inspection in accordance with the requirements specified in the Training Mode section.

3.133.12   Recall Previous Vehicle Tests & Reprint VIR

The RI2000 must be able to recall as well as provide VIR reprint capability for at least the latest 1000 test records in addition to any tests performed in the past 60 days.

The RI2000 shall provide prompts to the inspector to review or print, if required, a summary of the test result or the specific vehicle information. All files not transmitted to the HCS shall be stored on floppy disk.

The VIR reprint is not required to include the Diagnostic Report, Second by Second Information, nor any information not provided by TEST.DAT.

3.143.13   QA Functions

When the QA function is selected, the entries for 3.14.1 and 3.14.2 must be made prior to displaying the QA Menu. The QASTAFF.DAT and the QAAUDIT.DAT files will be utilized.

3.13.1 *QA Staff License Number Entry*

DISPLAY PROMPT:

SCAN THE BAR CODE ON YOUR QA STAFF BADGE OR PRESS --- (FUNCTION KEY) FOR MANUAL ENTRY.

a   *Programming Criteria:*

1   The validity of a QA Staff's license number and access code will be verified by the RI2000. If a QA Staff scans a bar-coded QA Staff license number that is not stored in the QA Staff Information Table, the RI2000 shall display the following message:

DISPLAY PROMPT:

THE QA STAFF LICENSE NUMBER IS NOT IN THE RI2000. CONTACT KTI HOTLINE.

2   In cases where the badge cannot be successfully scanned, the QA Staff shall be given the option of manual entry via the following prompt:

DISPLAY PROMPT:

ENTER YOUR QA STAFF LICENSE NUMBER.

If accepted by the RI2000, the QA Staff license number shall be written to the *QA Staff License Number* field of QAAUDIT.DAT.

3   The HCS shall transmit QA Staff license numbers, expiration dates, as an update of the entire QA Staff table to the RI2000. The RI2000, upon receiving this information from the HCS, shall read and store this information in the appropriate locations within the QA Staff Information Table. Print the QA Staff's name and license number on the VIR for tests performed.

3.13.2 *QA Staff Access Code Entry*

After entry of the QA Staff's license number, the RI2000 shall require manual entry of the QA Staff access code.

DISPLAY PROMPT:

ENTER YOUR QA STAFF ACCESS CODE.

a   *Programming Criteria:*

1   Do not display actual entries on the screen, use X's.

2   The access code must match the code stored internally in the QA Staff Information Table. The RI2000 shall allow three attempts to enter a valid access code. Following each of the first two attempts, the following message shall be displayed.

DISPLAY PROMPT:

YOUR ACCESS CODE IS NOT VALID - TRY AGAIN.

3   After the third unsuccessful attempt, the following message shall be displayed.

DISPLAY PROMPT:

THE ACCESS CODE ENTERED IS NOT VALID. CONTACT KEATING.

The RI2000 shall return to the Main Menu.

~~When the QA function is selected, the entry for the QA Staff Password~~

~~Entry must be made prior to displaying the QA Menu.~~

~~1.1.1 QA Staff Password Entry~~

~~DISPLAY PROMPT:~~

~~ENTER THE QA STAFF ACCESS CODE.~~

~~a Programming Criteria:~~

~~1 The validity of a QA Staff's access code will be verified by the RI2000.~~

~~DISPLAY PROMPT:~~

~~YOUR ACCESS CODE IS NOT VALID - TRY AGAIN.~~

~~2 After the third unsuccessful attempt, the following message shall be displayed.~~

~~DISPLAY PROMPT:~~

~~THE ACCESS CODE ENTERED IS NOT VALID. CONTACT KEATING.~~

~~The RI2000 shall return to the Main Menu.~~

~~1.1.2~~3.13.3   QA/State Menu

Once access to the QA/State Menu functions has been allowed, the RI2000 shall monitor for keyboard strokes. If the RI2000 does not detect keyboard strokes and/or processor activities continuously for five minutes, the RI2000 shall automatically close the QA/State Menu and return to the Main Menu. The function at the time of the automatic closure shall be aborted.

Information contained in the files associated with the QA/State Menu shall be hidden in software to Rhode Island's satisfaction.

The manufacturer shall display the following menu options for the QA inspectors and State representatives:

a   *RI2000 AUDIT SCREEN*

b   *UPDATE STATION INFORMATION*

c   *VIEW INSPECTOR INFORMATION*

d   *INSTALL NEW DATA DISK*

e   *LOCKOUT RI2000*

f   *PERFORM SOFTWARE UPDATE*

g   *SEARCH AND RETRIEVE TEST RECORD*

h   *COMMUNICATIONS LOG*

I   *PERFORM CHALLENGE TEST*

J   *RECALL WAIVER HISTORY*

k   *RECALL REPAIR RECORDS*

L   *WAIVER AUTHORIZATION AND ISSUANCE*

m   *RI2000 AUDIT*

(Note: This requirement for RI2000 will be deferred until 03/01/2000.)

n   *PE MODE*

(Note: This requirement for RI2000 will be deferred until 03/01/2000.)

~~1.1.33~~.13.4 RI2000 AUDIT SCREEN

(Note: This requirement for RI2000 will be deferred until 03/01/2000.)

a   *Display*

The RI2000 shall display the following parameters in this screen:

1   The actual PEF values must be displayed along with the raw gas analyzer readings.

2   Dynamometer Speed

3   Dynamometer Load

4   Roll RPM

5   VMAS Dilute flow

6   VMAS Dilute O2

7   Opacity Reading

8   RPM

9   Raw Transport Determination Time stored

10   Raw Transport Check Time stored

11   Ambient Temperature

12   Barometric Pressure

13   Relative Humidity

14   V~MAS~™ Temperature

15   V~MAS~™ Pressure (ACFM)

b   *Additional Audit Features*

The RI2000 shall run the following tests and display the timing results without effecting stored values or lockout:

1   Raw Transport Time Determination

2   Raw Transport Time Check

~~3.14.4~~3.13.5 *Update Station Information*

Selecting this item will cause the RI2000 to display a table showing the following station information. This information is entered by QA/State Personnel or FSRs (from FSR menu) upon initialization of the station and when the information changes, and shall be stored in the CONFIG.DAT file. Fleet stations shall have Station License Number format 'F' followed by 7 alphanumeric.

DISPLAY PROMPT:

STATION LICENSE NUMBER: (8 alphanumeric)

RI2000 NUMBER: (8 ALPHANUMERIC)

~~3.14.5~~3.13.6 *View Inspector Information*

The inspector information (TECH.DAT) shall be transferred from the HCS to the RI2000. The RI2000 shall provide viewing option to the State/QA inspector. For viewing purposes, the inspector middle initial shall be displayed rather than the full middle name. The first and last names may be truncated, subject to approval by KTI, to accommodate display on the screen. When the inspector information is displayed, a function key must be pressed to display the inspector access code. The inspector access code shall be displayed for two seconds after the function key is pressed. The inspector access code shall never be printed.

~~3.14.6~~3.13.7 *Install New Data Disk*

The manufacturer shall display instructions, on a single screen, for changing the floppy disk. The instructions shall meet Program Administrator approval. If the floppy disk is changed, the RI2000 shall check the newly installed data disk for existing RI2000 records and shall perform a disk check for corruption. If RI2000 records are found, the RI2000 must prompt the user to install a blank disk. Once a valid floppy disk has been installed, the RI2000 shall automatically format the new floppy disk.

~~3.14.7~~3.13.8 *RI2000 Lockout/Tamper*

When this item is selected, the RI2000 shall display the list of the lockouts/tampers found in LOCKOUT.DAT and current lockout/tamper status..

DISPLAY PROMPT:

SELECT "Y" FOR YES TO SET LOCKOUT.

SELECT "N" FOR NO TO CLEAR LOCKOUT.

The following can be cleared by the QA/State Representatives:

- QA/State Lockout

- Cabinet Tamper Lockout

- VMAS Tamper Lockout

- No Contact Limits Lockout (RI2000 no contact counters shall be restarted)

The following can be set by the QA/State Representatives:

- QA/State Lockout

The software shall display a message if the RI2000 is locked out from I/M testing.

~~3.14.8~~3.13.9 *Perform Software Update*

If an emergency software update is required, the RI2000, using this menu selection, shall allow Rhode Island representative or the QA inspector to install the software update on affected, if applicable, RI2000 units.

If this menu selection is made, the RI2000 shall display the following prompt:

DISPLAY PROMPT:

DO YOU WANT TO PERFORM AN EMERGENCY SOFTWARE UPDATE? (YES/NO)

a   Programming Criteria:

   1   If Yes, the RI2000 shall automatically open the door to the floppy or (if a lock mechanism is used) shall display a message regarding how to open the door. The RI2000 shall then prompt to insert the update disk in the state drive and press a function key to implement the software update. After the update has been completed, the RI2000 shall prompt to remove the update disk and close the floppy door. The RI2000 shall then return to the QA/State menu.

   2   If No, the RI2000 shall return to the QA/State menu.

~~3.14.9~~3.13.10   *Search and Retrieve Test Records*

The search shall locate, display and printout completed test and calibration records based on knowledge of the vehicle license plate number, license type, VIN, date/time or sticker number. Once a test record is located, the QA/State Representative shall be allowed to review the previous test records as well as those which follow the target record. If an exact match is not found, the closest match shall be displayed. Once a record is

located, the QA or state representative shall be allowed to review the complete vehicle inspection or calibration record and print those records using the VIR printer.

3.14.103.13.11   Communications Log

This function will allow the QA or State Representative to print the communications log. The RI2000 shall keep a log of the 1000 most recent communication transactions.. (This log shall also be made available to the manufacturer's representatives in the FIELD SERVICE MENU.)

3.14.113.13.12   Perform Challenge Test

If this menu item is selected, the QA/State Representative shall have an option to perform a challenge test. A challenge test for a particular vehicle must be performed at the station it was previously tested. The TEST.DAT file will be utilized. Test Sequence Type in TEST.DAT shall be set to "C".

The testing sequence shall be the same as if this command was selected through the test "Inspection" menu option in Section 3.6. Input described in 3.6.1 and 3.6.2 will not be required. These fields will be occupied with the QA/State Representative's License Information. The exceptions for the challenge tests are as follows:

a   *A test authorization will not be used. If the test authorization is not available, the test authorization field in TEST.DAT shall be filled with 9's.*

b   *Test will be performed with the same rules as a retest (i.e. only the failing components will be tested.)*

c   *The test does not count as a retest.*

d   *There is no fee collected.*

3.14.123.13.13   Recall Waiver History

When this menu item is selected, the RI2000 shall prompt the operator to enter the vehicle information as described in the Initial Vehicle Data Entry section. Upon transmission to the HCS, if records are found, the HCS will transmit up to 10 of the most recent waiver records. The software shall allow the operator to only view and/or print a user-selectable number of records.

3.14.133.13.14   Recall Repair Records

3.14.14When this menu item is selected, the RI2000 shall prompt the operator to enter the vehicle information as described in the Initial Vehicle Data Entry section. Upon transmission to the HCS, if records are found, the HCS will transmit up to 10 of the most recent repair records. The software shall allow the operator to only view and/or print a user-selectable number of records.

3.13.15   Waiver Authorization and Issuance

Three different types of waivers may be issued by the RI2000 analyzer. Note that a particular vehicle may only be issued an Emission Repair Time Delay Waiver once in its lifetime, unless Multiple Emission Repair Time Delay Waivers Allowed = Y in NETWORK.DAT.

This function allows QA staff members to issue Emissions Waivers to specific vehicles. Upon selection, data required in section 3.6.3, and 3.6.7 up to and including Vehicle Make must be entered or scanned. The data entry content and sequence shall be the same as 3.6.3 and 3.6.7 up to and including Vehicle Make. If the waiver function is aborted, the RI2000 shall return to the QA Menu. The WAIVER.DAT file will be utilized. The Test Number field in WAIVER.DAT will be populated using the same criteria for the Test Number field in TEST.DAT. The following sequence shall be observed:

a   *Prompt the QA Representative:*

> **DISPLAY PROMPT:**

> **ENTER THE WAIVER REASON:**
>
>> **1) Emission Repair Cost Limit Waiver (L)**
>>
>> **2) Diagnostic Emission Waiver (D)**
>>
>> **3) Emission Repair Time Delay Waiver (T)**

1   Program Criteria

i   "Emission Repair Time Delay Waiver" will only appear on the menu if the *DMV Headquarters Facility* field in CONFIG.DAT contains a "Y".

ii   The analyzer shall store the waiver reason (L, D, or T) in the Waiver Type field of WAIVER.DAT.

iii   The workstation will not proceed until proper entry is obtained.

iv   Once proper entry is obtained, the waiver date and time shall be recorded to WAIVER.DAT.

b   *Prompt the QA Representative:*

> **DISPLAY PROMPT:**

> **WERE REPAIRS PERFORMED ON THIS VEHICLE WHICH WERE NOT RECORDED DURING ANY PREVIOUS INSPECTION?**

1   Program Criteria

  i   If the response is "Yes" then perform Repair Logic as shown in section 3.6.

  ii   The workstation will not proceed until proper entry is obtained.

DISPLAY PROMPT:

A WAIVER FOR A VEHICLE HAS BEEN STARTED.

GATHERING VEHICLE DATA FOR A WAIVER

DO YOU WISH TO PROCEED? YES OR NO

  iii   The workstation will not proceed until proper entry is obtained.

  iv   The workstation will allow escape from this process and return to the State Menu.

  v   Entry defined in 3.6.3, and 3.6.7 up to and including Vehicle Make (this is to provide all information necessary for printing the sticker – not all of the information is stored in WAIVER.DAT)

  vi   The workstation shall use the communications software to contact the HCS to transmit the waiver request.

  vii   The workstation shall issue a waiver only if:

  - There is ~~successful communication with the HCS, and~~a match found at the HCS (indicated by receipt of a waiver record from the HCS), and

  - For waiver type "T", if Multiple Emission Repair Time Delay Waivers Allowed = Y (NETWORK.DAT) or the "Emission Repair Time Delay Waiver Previously Issued" flag is not set by the HCS.

viii   If previous criteria are fulfilled, the RI2000 shall print a Waiver VIR and a sticker per section 3.6.

ix   The transaction type shall be set to "W" waiver by the analyzer.

x   A new Test Authorization will not be used – the number will be received from the HCS in the waiver record.

xi   Once the waiver is issued, all applicable waiver information shall be stored in WAIVER.DAT.

~~3.14.15~~3.13.16   RI2000 AUDIT

(Note: This requirement for RI2000 will be deferred until 03/01/2000.)

(Reserved - Requirements will be defined for startup implementation.)

~~3.14.16~~3.13.17   PE MODE

(Note: This requirement for RI2000 will be deferred until 03/01/2000.)

(Reserved - Requirements will be defined for startup implementation.)

If this menu item is selected, the QA/State Representative shall have an option to perform a PE Test. When this item is entered from the QA/State menu, the Inspector Access code in TEST.DAT shall ~~be stored as QA9999999~~contain the QA/Staff license number. The testing sequence shall be the same as if this command was selected through the test "Inspection" menu option in Section 3.6. Input described in 3.6.1 and 3.6.2 will not be required. The TEST.DAT will be utilized. Test Sequence Type in TEST.DAT shall be set to "P".

Once all the above official tests are performed, the analyzer shall perform an additional test cycle. PE Test Cycle will be performed. PE Test cycle consists of a 240-second drive cycle. The cycle will be performed once. These cycles will not serve as the official test scores but all quality assurance features described in an official test must be applied.

If the test is entered through the PE Testing menu item, the PE Tests shall be performed on that RI2000 unit even if it is not marked to be performed in the CONFIG.DAT file.

Other than the stated exceptions, all other function are the same as an INSPECTION main menu selection.

~~3.15~~3.14   Station Manager Menu

The RI2000 shall only allow authorized personnel (station manager's access code) to enter this feature.

1.   PURCHASE TEST AUTHORIZATION NUMBERS

2.   REVIEW AUTHORIZATION INVENTORY/ MONTHLY

PAYMENT/STICKER STATUS

3.   DATA FILE REFRESH

4.   UPDATE NETWORK COMMUNICATIONS DATA

5.   STATION IDENTIFICATION

6.   SET STATION PASSWORD

7.   LOAD STICKERS

8.   PRINT MONTHLY BILLING STATEMENT REPORT

~~3.15.1~~3.14.1 *Purchase Test Authorization Numbers*

This function will allow test authorizations be purchased via the network. Upon selection, network access shall be attempted and, if successful, test authorizations may be ordered. If transmission of test authorizations is successful, then the test authorizations shall be returned (in the TEST AUTHORIZATIONS data file) either immediately or at a subsequent network access and should be stored in the REVIEW TEST AUTHORIZATION INVENTORY file.   If sufficient funds are not available, the HCS shall set a lockout. The RI2000 shall display the following menu items under purchase additional test authorization numbers:

a   SET AUTOMATIC ORDER QUANTITY – INVENTORY TYPE 1 AND INVENTORY TYPE 2

b   MANUAL ORDER

When automatic order quantity is selected, the RI2000 shall allow the operator to set the low test authorization warning thresholds and set the numbers for automatic test authorization order, for each inventory type. When manual order is selected, the RI2000 shall commence with test authorization purchase.

1   Programming Criteria:

i   Prompt the QA Representative:

DISPLAY PROMPT:

ENTER THE INVENTORY TYPE:

1. One-Year Authorizations (Type 1)

2. Two-Year Authorizations (Type 2)

DISPLAY PROMPT:

TRANSMITTING DATA, PLEASE WAIT.

ii   Test authorizations purchase request will be transmitted to HCS.

iii   Upon successful transmission of the request, the RI2000 shall display the following message provided that test authorizations are not sent from HCS at this time:

DISPLAY PROMPT:

**TEST AUTHORIZATION ORDER HAS BEEN PLACED.
ENSURE THAT ACCOUNT HAS SUFFICIENT FUNDS.**

iv   Upon receipt of test authorization numbers, the RI2000 shall display the following message:

DISPLAY PROMPT:

TEST AUTHORIZATIONS RECEIVED.
The RI2000 shall display a TEST AUTHORIZATION RECEIVED message and shall print a receipt, as received in a message from the HCS, as shown below:

ELECTRONIC TEST AUTHORIZATION NUMBER PURCHASE RECEIPT

Date: MM/DD/YYYY   Station: Station License #

Time: HH:MM   RI2000 ID: RI2000 #

Inventory Type: Inventory Type #

Test authorizations have been issued to this station via electronic transfer. If purchase has not been pre-paid, usage of these test authorizations will be revoked immediately if payment is not received.

For example:

Range of Auth #	Total Auth #	Cost/Auth	Total Cost	Inventory Type
100000000-100000024	25	$X.XX	$XXX.XX	X

Note: List each range of 25 test authorizations.

v   If the requestor s bank cannot honor the debit

transaction due to insufficient funds in the requestor s account, etc., the RI2000 shall be locked out. The RI2000 shall display the following message:

DISPLAY PROMPT:

INSUFFICIENT FUNDS. THE RI2000 SHALL BE LOCKED OUT. CALL KTI ACCOUNTING DEPARTMENT.

vi   If a test authorization order will not be acknowledged until funds are received, then the following message will be displayed:

DISPLAY PROMPT:

FUNDS MUST BE CLEARED THROUGH DEBIT PROCESS BEFORE TEST AUTHORIZATIONS ARE ISSUED.

vii   If a test authorization order is not approved by KTI, then the following message will be displayed:

DISPLAY PROMPT:

PURCHASE IS NOT AUTHORIZED. CONTACT NEAREST KTI OFFICE.

The number of test authorizations remaining, for each inventory type, shall be displayed before each Inspection. When the number remaining drops below a pre-defined threshold, a warning message will be displayed.

DISPLAY PROMPT:

ONLY X ONE-YEAR TEST AUTHORIZATIONS REMAIN. REORDER TEST AUTHORIZATIONS.

DISPLAY PROMPT:

ONLY X TWO-YEAR TEST AUTHORIZATIONS REMAIN. REORDER TEST AUTHORIZATIONS.

The following data, stored in a method determined by the RI2000 manufacturer, shall be modified through this menu item (Number of test authorizations remaining to trigger reorder should be defaulted to 20):

Description	Length	Format
Low test authorization warning	3	Numeric

threshold, type 1

Number of test authorizations remaining to trigger re-order, type 1	3	Numeric
Low test authorization warning threshold, type 2	3	Numeric
Number of test authorizations remaining to trigger re-order, type 2	3	Numeric

If the station has authorized automatic re-ordering (provided that the number of test authorization lots to be automatically re-ordered is 25), the RI2000 shall automatically place a test authorization order once the number of remaining test authorizations drops to a pre-defined threshold (number of test authorizations to trigger re-order is between 0 and 25; 0 = manual ordering). The automatic test authorization re-ordering function is pre-set by the station manager or authorized personnel.

Automatic reorder shall not be triggered until previously ordered test authorizations have been received.

~~1.1.2~~3.14.2 *Review Test Authorization Inventory/ Monthly payment/Sticker Status*

This feature shall display the number of all test authorizations currently residing in the inventory. All monthly payments received and accepted by the HCS shall be displayed in the inventory. The RI2000 shall display as follows:

DISPLAY PROMPT:

REVIEW TEST AUTHORIZATION INVENTORY

ONE-YEAR (TYPE 1) INVENTORY:

   XXxxxxxx to XXxxxxxx

THERE ARE XXX TEST AUTHORIZATIONS REMAINING IN INVENTORY

TWO-YEAR (TYPE 2) INVENTORY:

   XXxxxxxx to XXxxxxxx

THERE ARE XXX TEST AUTHORIZATIONS REMAINING IN INVENTORY MONTHLY PAYMENT EXPIRATION

MM-DD-YYYY

THERE ARE XXX DAYS BEFORE THE MONTHLY PAYMENT EXPIRES

REVIEW STICKER INVENTORY

XXxxxxxx to XXxxxxxx

THERE ARE XXX STICKERS REMAINING IN INVENTORY

~~1.1.33.~~14.3 *Data File Refresh*

This feature shall allow the station manager to place a request to the HCS to update date and time, Rhode Island messages (if applicable), test authorizations (that the RI2000 currently uses and those, if any, that are stored in the inventory), inspector's information, STD Tables and lockout status.

The RI2000 shall overwrite the existing tables with the refreshed data received from the HCS when applicable.

Whenever a DATA FILE REFRESH is selected and before performing the data refresh procedure, the RI2000 shall display the following message (Alternative methods may be used upon approval by Rhode Island):

DISPLAY PROMPT:

THE HCS SHALL UPDATE RI2000 FILES.

Prior to performing the DATA FILE REFRESH, the RI2000 shall provide a method to display a list of inspector license number endorsements and expiration dates. The RI2000 shall also display the test authorization number inventory that currently exists in the RI2000 and shall provide an option to print, if desired. Then the RI2000 shall prompt the inspector to perform the refresh procedure.

Upon completion of the DATA FILE REFRESH procedure, the RI2000 shall display the following message:

DISPLAY PROMPT:

RI2000 FILES HAVE BEEN UPDATED. PLEASE CHECK IF THERE ARE PROBLEMS, CONTACT YOUR LOCAL KEATING FIELD OFFICE.

The RI2000 shall provide a method to display the updated list of inspector license numbers, any new Rhode Island messages (if applicable), and test

authorization number inventory.

During screen display or printing of the inspector information, the RI2000 shall not display the actual inspector access codes (hidden) so that they may not be viewed by unauthorized person(s).

~~1.1.4~~3.14.4 Update Network Communications Data

When selected, prompt for entry of the HCS phone number, which shall be required for communications and stored in a method determined by the RI2000 manufacturer:

Primary network phone number: "(XXX) XXX–XXXX"

~~1.1.5~~3.14.5 Station Identification

This function shall be in the Station Manager menu to allow the station name and address information to be changed and printed on the VIR. Fields required for entry of this information shall be as follows:

- Station Name - 50 characters

- Address Line 1- 50 characters

- Address Line 2- 50 characters

- City - 50 characters

- State - 2 upper case characters (RI is default)

- Zip - 10 characters

- Station Business Phone Number – 14 Characters

~~3.15.6~~3.14.6 Set Station Password

This function will allow the 5-character station password, stored in a method determined by the RI2000 manufacturer, to be changed.

~~1.1.7~~3.14.7 Load Stickers

Selection of this item will cause the analyzer to instruct the manager to enter the first and last serial numbers of the stickers loaded into the system. If a new batch of stickers is loaded and the previous batch is not completely used, the RI2000 shall prompt the Station Manager to enter the status of the remaining stickers in previous batch. A range of or an individual sticker(s) may be Void, Missing, Stolen, or Damaged. Each sticker Void, Missing, Stolen, or Damaged shall result in a record in the STCKVOID.DAT file. The RI2000 shall not prompt the manager for a range, but shall automatically apply the status indicated by the manager to each of the remaining stickers in previous batch.

The following display shall be used to load stickers. The STICKER.DAT file will be utilized. Only one batch (of ~~XX~~300 stickers) with a consecutive range may be entered (loaded) into the RI2000.

DISPLAY PROMPT:

ENTER THE FIRST AND LAST SERIAL NUMBERS OF THE INSPECTION STICKERS LOADED INTO THE SYSTEM.

a   Error Message:

DISPLAY PROMPT:

NO VALUES ENTERED -- TRY AGAIN

In this screen, the user shall be able to configure the following, stored in a method determined by the RI2000 manufacturer:

Description	Length	Format
Low sticker warning threshold	3	Numeric

~~1.1.8~~3.14.8 *Monthly Billing Statement Report*

(Note: This requirement for RI2000 will be deferred until 03/01/2000.)

Upon selection the workstation will perform network access and, if successful, the workstation shall request the return of a monthly billing report.

DISPLAY PROMPT:

A MONTHLY BILLING STATEMENT REPORT REQUEST HAS BEEN STARTED.

THIS REPORT WILL CONTAIN THE FOLLOWING INFORMATION:

THE NUMBER OF AUTHORIZATIONS ORDERED AND DEBITED;

THE NUMBER OF AUTHORIZATIONS USED;

THE CURRENT INVENTORY OF AUTHORIZATIONS HELD BY THE STATION;

THE MONTHLY WORKSTATION FEES DEBITED;

~~ANNUAL STATE STATION LICENSE FEES DEBITED;~~

ANY CREDITS ISSUED AND/OR USED; AND

OTHER INFORMATION NEEDED BY THE OPERATOR TO PERFORM ACCOUNTING AND OTHER BUSINESS

FUNCTIONS AT THE STATION.

THE INFORMATION ON FILE GOES ONLY AS FAR BACK AS THE LAST BILLING PERIOD, WHICH IS AVAILABLE FOR THE NEXT ENTIRE MONTH UNTIL A NEW STATEMENT IS PREPARED. MONTHLY STATION ACCOUNTING STATEMENT REPORT WILL BE AVAILABLE ON THE FIRST MONDAY FOLLOWING THE FIRST WEEKEND OF THE MONTH. THE REPORT WILL BE AVAILABLE FOR THE BALANCE OF THE MONTH AND AT THE START OF THE FOLLOWING MONTH UNTIL THE NEXT BATCH JOB IS RUN.

THERE WILL BE NO CHARGE TO THE STATION FOR THIS REPORT. YOU MAY EXIT AT ANY TIME PRIOR TO FINAL PLACING OF THE CALL TO THE MAIN HOST COMPUTER.

DO YOU WISH TO PROCEED? YES OR NO

a   *Programming criteria:*

1   The workstation will not proceed until proper entry is obtained.

2   If the user chooses not to proceed return to Station Menu.

3   If, network access to the HCS is not achieved display the following message:

DISPLAY PROMPT:

ERROR: CANNOT ACCESS NETWORK

4   The workstation will allow escape from this process and return to the Station Menu.

5   The workstation shall use the communications software to contact the HCS with the report request.

6   The HCS will return the Billing Statement report (per the communication specification) in the same communications session. Upon receipt the workstation will display and print in the normal manner for received mail.

~~3.16~~3.15   Program Communications

(Note that Program Communications items are deferred until 03/01/2000)

The emissions workstations must support program communication tools and services.

~~1.1.1~~3.15.1 *Intranet Messaging Functions*

The RI2000 shall support receipt, storage, display and printing of a monthly newsletter. The newsletter will be 4-8 pages long. Viewing and printing will be a user option.

Methodology shall be as follows:

The RI2000 shall contain the following directory in which to organize this information: C:\INTRANET\MSG0 ("zero", not "oh").

All files comprising the newsletter shall be compressed to size <= 50K into a single document using PKZIP©, and transmitted to the workstation using the naming convention MSG0.ZIP ("zero", not "oh"). The compressed set of files shall be decompressed and stored in the C:\INTRANET\MSG0\ Directory. The zipped newsletter file shall contain the file MESSAGE.HTM, an HTML formatted Station Newsletter file. In addition, the zipped newsletter file shall contain all files referenced by the HTML document, such as graphic files. Graphic files shall be of type .JPG or type .GIF. All files contained within the .ZIP file shall conform to the short (DOS) file naming conventions.

The following capabilities shall be available on the RI2000:

- Ability to download preformatted Station Newsletters from the HCS

- Ability search for key fields within the document

- Ability to easily review the document on the screen.

- Ability to print document

- Support printing of individual pages

If a new Station newsletter is received, the previous Station newsletter files may be purged, and the new Station newsletter written to the appropriate directory and files. If a new Station newsletter is received and has not yet been viewed, it shall be displayed at the end of the next inspection, or the RI2000 shall notify the inspector that a new station newsletter has been received, and instruct the inspector to view the newsletter.

~~3.17~~3.16   Field Service Representative (FSR) Functions

When the FSR Functions is selected, the entry for the FSR access code must be made prior to displaying the FSR Menu.

~~1.1.1~~3.16.1 *FSR Access Code Entry*

DISPLAY PROMPT:

ENTER THE FSR ACCESS CODE.

a   Programming Criteria:

1   Do not display the actual entry on the screen; use X's.

2   The access code must match the code generated by the manufacturer's daily access code algorithm. The RI2000 shall allow three attempts to enter a valid access code. Following each of the first two attempts, the following message shall be displayed.

DISPLAY PROMPT:

YOUR ACCESS CODE IS NOT VALID - TRY AGAIN.

3   After the third unsuccessful attempt, the following message shall be displayed.

DISPLAY PROMPT:

THE ACCESS CODE ENTERED IS NOT VALID. CONTACT KEATING.

The RI2000 shall return to the Main Menu.

~~1.1.23~~.16.2 *Service Logs*

(Note that Service Logs are not required on the RI2000 until 03/01/2000.)

The system shall keep a maintenance log to record all service calls. The FSR should fill in the FSR log for all applicable service calls. The function can be manually initiated by the FSR when desired.

The log must allow the FSR to list the activities performed, the items fixed and the parts replaced. Data entered shall be written to the FSRLOG.DAT file.

a   Programming Criteria:

1   A selection list containing all Components listed as Item Code Descriptions in the table in FSRLOG.DAT shall be displayed. Each time an item is selected, the following message shall be displayed:

DISPLAY PROMPT:

Enter the following information:

Work Code:

I.   Installed

R.   Repaired

P.   Replaced

D.   Diagnosed (not repaired)

2   If the Work Code selected is I or P, the following message shall be displayed:

DISPLAY PROMPT:

SERIAL NUMBER: (12 ALPHANUMERIC)

DESCRIPTION: (70 ALPHANUMERIC)

3   Note: Serial Number shall only be displayed for those items it is required for, as listed in the table for FSRLOG.DAT.

The information entered will be transmitted to the HCS during the next communications. One record is written for each component in the FSRLOG.DAT file. The RI2000 shall store the entered serial numbers in a manufacturer designated area for subsequent display, and to make them available for storage in CAL.DAT. If there has been no entry for a component that requires a serial number, the field should be blank.

~~1.1.3~~3.16.3 *Update Station Information*

Selecting this item will cause the RI2000 to display a table showing the following station information. This information is entered by QA/State Personnel (from QA/State Menu) or FSRs upon initialization of the station and when the information changes, and shall be stored in the CONFIG.DAT file. Upon entry or modification of this information, the HCS password shall be set per the communication specification.

DISPLAY PROMPT:

STATION LICENSE NUMBER: (8 ALPHANUMERIC)

RI2000 NUMBER: (8 ALPHANUMERIC)

~~1.1.4~~3.16.4 *Update Station Configuration*

Selecting this item will cause the RI2000 to display a table or menu showing the possible workstation configurations as described in the Workstation Configurations section. The FSR shall be instructed to select the configuration applicable to the workstation, which shall then be stored in the CONFIG.DAT file.

DISPLAY PROMPT:

SELECT WORKSTATION CONFIGURATION: (1-3~~, 2~~)

~~1.1.5~~3.16.5 *Raw Transport Time Determination (HC, CO, CO2, NO)*

(Note: This requirement for RI2000 will be deferred until 03/01/2000.)

If the Raw Transport Time Check fails, a Response Time Determination will be performed.

A calibration record shall be initiated in the manner described in the Calibration Menu section.

To determine the raw sample transport time, the following procedure shall be followed:

a   *Perform zero and hang-up.*

b   *Place sample system into backpurge mode*

c   *Using gas analyzer audit apparatus, flow high span gas while the probe is placed into the tailpipe simulator.*

d   *Instruct the operator to turn on gas and press start.*

e   *A timer starts when the sample system goes into sample mode.*

f   *Track and store the time required by the raw analyzer to reach T_{XX} for all constituents (where XX is Raw Transport Time Determination T_{XX} field in the NETWORK.DAT file – default 50%).*

g   *If the sample system response changes by more than 1 second for any constituent, a warning message shall be provided to the FSR.*

h   *Immediately following the Transport Time Determination, the RI2000 shall perform a Raw Transport Time Check. The analyzer shall not be zeroed and a hang-up test shall not be performed.*

i   *The measured time shall be used as the benchmark value for the Raw Transport Time Check performed in the Calibration Menu.*

~~3.17.6~~3.16.6 Flow Audit/Calibration

(Note: This requirement for RI2000 will be deferred until 03/01/2000.)

The CAL.DAT file will be utilized. A calibration record shall be initiated in the manner described in the Calibration Menu section.

a   *Check flow rate with all hoses removed. If flow rate reading is within 10% of stored reference value, then calibration is not required. Reference flow rate is set during installation for a specific $VMAS^{\hat{O}}$ unit and blower.*

b   *If flow check is not within 10% of reference value, perform a 2 point calibration. Using a reference flow meter with 1% accuracy, set high calibration point to 350 – 380 SCFM. An adjustable flow restrictor will be required. Exhaust hose will have to be removed to achieve flow rate. Use host software to calibrate the $VMAS^{\hat{O}}$ to the reference flow. Adjust flow to 230 – 260 SCFM and calibrate the low point in the same manner.*

c   *Adjust flow back to 350 – 380 SCFM and perform audit with reference*

flow meter. Flow reading should be within 5% of reference flow.

d   *Reset reference flow rate with all hoses removed.*

~~3.17.7~~3.16.7 *Additional FSR Functions*

The content of this section can be implemented in this menu or in another manner better suited to the RI2000 manufacturer. The RI2000 manufacturer shall submit descriptions for these functions. The RI2000 manufacturer shall have the ability to perform the following functions:

a   *View Information Menu*

    1   Lockout status

    2   System status

    3   View inspector information

    4   Station information

    5   Network communications log

b   *Loaner Unit Functions*

c   *Initial Calibrations*

d   *Network Communications Data*

e   *Install New Data Disk*

f   *Update VLT*

g   *Update DLT*

h   *Update SDM.DAT*

i   *Update AVGSBS.DAT*

j   *Update AVGCYCLE.DAT*

Items f-j shall be updated quarterly during audits by the FSR via CD.

~~1.1.8~~3.16.8 *Raw Extracted Volume*

The RI2000 gas analyzer extracts a small volume of exhaust from the tailpipe during a test, which must be compensated for in the mass calculations. The RI2000 computer shall download the raw exhaust sample flowrate, in liters/minute, to the V~~MAS~~™ microprocessor which will add this amount to the exhaust volume calculation and the pollutant mass calculations.

~~3.18~~3.17   RI2000 Audit

(Note: This requirement for RI2000 will be deferred until 03/01/2000.)

a   *This function shall be available on the QA Staff and FSR menus. The audits will be performed by the FSR. The QAAUDIT.DAT file will be used.*

The FSR Staff shall enter responses for the following items as prompted below:

DISPLAY PROMPT:

ENTER PASS, FAIL, OR NOT DONE FOR EACH ITEM BELOW:

- **Emissions Analyzer and Mass Measurement System:**

Verification of serial numbers.

Inspections for cleanliness, physical abuse and/or tampering.

Check and replace filters.

Verification of all required external analyzer labels.

Verification of analyzer calibration gas and zero gas.

Verification of calibration frequencies.

Verification of sample hose and probe compliance with specifications.

Perform analyzer leak check.

Perform analyzer accuracy gas audit.

Check raw and dilute analyzer timing synchronization.

Check dilute flow levels.

Check dilute analyzer calibration.

Check functionality of peripheral devices such as bar code reader, RPM sensors, printers, remote controls and keyboards.

Perform gas cap calibration verification.

- **Dynamometer:**

Observation of dynamometer operation.

Verification of identification plate information.

Review calibration and coast down records.

Perform an automatic calibration.

Check of vehicle restraint system.

Review of safety procedures.

The analyzer shall store the entries in the QAAUDIT.DAT file.

b   This function shall be available on the QA Staff and FSR menus. The audits will be performed by the FSR. The AUDIT.DAT file will be used. The FSR Staff shall perform an audit of the following requirements at the following frequencies:

System	Procedure	Frequency	Description
Bench	5 point audit	6 Months	Per section 2 and section below
Sample System	Leak Test – Section 3.9	6 Months	Per Calibration Section
VMAS	Vortex Strut Check	6 Months	Per Calibration Section
Dilute Flow	Flow Audit	6 Months	Per Flow Audit section

Results from the audit will be transmitted to the HCS during the next communications. The system shall indicate when all of the audits were performed last.

c   The Bench Audit (Gas Audit) shall be performed as follows:

Programming Criteria:

1   The analyzer shall be zeroed in accordance with a) Automatic Zero and b) Zero Drift Lockout Threshold in the Analyzer Requirements section.

2   Prompt user to inject gas:

DISPLAY PROMPT:

CONNECT AUDIT GAS TO PROBE USING AUDIT GAS FIXTURE, THEN OPEN BOTTLE TO INJECT GAS.

3   RI2000 shall display the gas values, with HC as propane, and instruct the operator as follows:

DISPLAY PROMPT:

PRESS ENTER TO ACCEPT VALUES WHEN STABILIZED.

4   Once the gases are stabilized and the operator presses

enter, the RI2000 shall prompt as follows:

DISPLAY PROMPT:

CLOSE GAS BOTTLE AND REMOVE AUDIT GAS FIXTURE FROM PROBE.

5   Once the gas bottle is closed, prompt the operator to enter the audit bottle values:

DISPLAY PROMPT:

USE BAR CODE SCANNER TO SCAN THE AUDIT BOTTLE USED.

6   Once the audit procedure is complete, the RI2000 shall determine the gas audit result and store the audit record in AUDIT.DAT. Tolerances for determining the gas audit result are in NETWORK.DAT. Audit results to be displayed to the screen include the following: accepted readings, scanned bottle values, tolerances, and gas audit result. The display shall also indicate what constituents failed the audit.

~~3.19~~3.18   Turnaway Document

(Note: This requirement for RI2000 will be deferred until 03/01/2000.)

A document will be printed by the RI2000 any time this menu is selected. The final version of this document will be supplied by KTI. The document supplied by KTI will be TURNAWAY.ZIP, compressed with PKZIP©, containing an HTML formatted document, named TURNAWAY.HTM, as well as any files referenced by TURNAWAY.HTM, such as graphics files. All files contained within the .ZIP file shall conform to the short (DOS) file naming conventions. The files shall be stored in C:\TURNAWAY\. This document will be used to explain what the vehicle owner should do if his/her vehicle is turned away from testing. The following is a generalized example of this document:

(Reserved - Requirements will be defined for startup implementation.)

~~3.20 Warranty Information~~

~~3.20 (Reserved - Requirements will be defined for startup implementation.)~~

1.1.1 Diesel Testing

The Diesel VLT (DLT) and the Diesel Standards Table (DSLSTD) shall be used.

a   *Light Duty Diesel Test Procedure*

1   Test Preparation

Prior to beginning the test, a smokemeter zero and full scale shall be performed, per the Calibration section. Some meter systems may automatically perform the zero and full scale checks. For other meters, this sequence will need to be done manually.

The system shall prompt the operator to perform the following functions:

DISPLAY PROMPT:

ENSURE THERE IS NO HAZARDOUS VEHICLE OR DYNAMOMETER CONDITION PRIOR TO DRIVING VEHICLE ONTO THE DYNAMOMETER. ABORT TEST AT ANY TIME IF ANY SUCH UNSAFE CONDITION IS OCCURRING OR CAN OCCUR.

CHECK ENGINE OIL LEVEL. THE LEVEL MUST BE WITHIN 1 QUART OF REQUIRED LEVEL. CORRECT BEFORE PROCEEDING WITH TEST.

TURN OFF ALL VEHICLE ACCESSORIES.

DRIVE VEHICLE ONTO THE DYNAMOMETER.

POSITION DRIVE WHEELS ON THE LIFT PLATE BETWEEN THE ROLLERS.

LOWER THE LIFT.

CENTER VEHICLE.

PLACE CHOCKS.

RESTRAIN VEHICLE.

POSITION FAN TOWARDS THE RADIATOR AIR INTAKE.

CHECK TO ENSURE VEHICLE IS PROPERLY WARMED UP.

FIRMLY HOLD STEERING WHEEL.

DO NOT TEST IN OVERDRIVE.

2   Test Sequence

    i   Dynamometer Controls

The analyzer shall set the dynamometer target speed to 30 mph.

The Road Load Horsepower shall be obtained from the DLT. If there is no DLT match, the default horsepower values shall be obtained from the DFLTHP.DAT file.

    ii   Gear Selection

The system will prompt the user to select the appropriate gear closest to direct drive.

DISPLAY PROMPT:

SELECT THE APPROPRIATE GEAR, CLOSEST TO DIRECT DRIVE.

    iii   Test Cycle

The following procedure will be followed:

a)   The system shall display appropriate prompts instructing the vehicle to be driven to 30 mph.

b)   The dynamometer shall apply a load to the vehicle as it increases in speed.

c)   The system shall display a test screen that shows real-time test parameters to assist the inspector in achieving test conditions in an efficient manner.

d)   When the vehicle speed and dynamometer load are within ± 5% of target for 5 seconds (stabilization period), the analyzer shall start the sample timer.

e)   The system shall automatically take opacity samples during a 15-second sample period.

NOTE: Should the vehicle speed and/or the dynamometer load exceed the ± 5% window during the sample period, the sample period is terminated and the 5 second stabilization period is re-entered prior to re-starting the 15 second sample timer.

f)   A 5-second running average of the opacity
readings shall be calculated by the analyzer.
The lowest average for the test period will be
utilized as the final results.

3   Second Chance

If the vehicle fails the initial test, the analyzer shall repeat the
test in its entirety. The results of the second test shall be
used to determine the pass/fail status of the vehicle under
test.

4   Data Storage

The emission values from the first test shall be stored in a
manner determined by the analyzer software until a pass/fail
decision on the emissions values has been determined. If the
emissions indicate a pass, the values from the first test shall
be written to the Diesel Light Duty Final Results fields of the
TEST.DAT file, and the 1st Chance(If Applicable) fields shall
remain blank.

If preconditioning and a second chance emissions test is
given, the second chance emissions values shall be written to
the Diesel Light Duty Final Results fields of the TEST.DAT
file. The results of the first test shall be written to the 1st
Chance(If Applicable fields of the TEST.DAT file.

If the results indicate a passed test, according to the cut
points in DSLSTD.DAT, "P" shall be recorded in the Diesel
Test Result field of TEST.DAT. Otherwise, "F" shall be
recorded.

5   End of Test

The dynamometer shall assist the vehicle in reducing speed
after the test has been completed or restarted. The system
will prompt the operator to:

DISPLAY PROMPT:

REMOVE FOOT FROM ACCELERATOR PEDAL.

APPLY BRAKES GENTLY-WARNING!

**BRING VEHICLE SPEED TO A COMPLETE STOP BEFORE
PLACING TRANSMISSION IN PARK.**

**REMOVE PROBE, COOLING FAN, WHEEL CHOCKS, AND
RESTRAINTS.**

Note: Item 2 shall caution the operator in an appropriate
manner (i.e., bright, flashing, etc.).

b   Heavy Duty Diesel Test Procedure

1   VEHICLE PREPARATION AND SAFETY CHECK

The system shall prompt the operator to perform the following functions:

i   Prior to beginning the test, a smokemeter zero and full scale shall be performed, per the Calibration section. Some meter systems may automatically perform the zero and full scale checks. For other meters, this sequence will need to be done manually.

ii   For vehicles with manual transmissions:

DISPLAY PROMPT:

PLACE THE TRANSMISSION IN NEUTRAL AND RELEASE THE CLUTCH.

iii   For vehicles with automatic transmissions:

DISPLAY PROMPT:

PLACE TRANSMISSION IN THE PARKED POSITION, IF AVAILABLE. IF NOT AVAILABLE, PLACE IT IN THE NEUTRAL POSITION, WITH MAXI OR PARKING BRAKE APPLIED.

iv   For all vehicles:

DISPLAY PROMPT:

CHECK VEHICLE WATER AND OIL TEMPERATURE GAUGE TO VERITY THAT THE ENGINE IS WITHIN ITS NORMAL OPERATING TEMPERATURE RANGE.

CHOCK WHEELS AND RESTRAIN VEHICLE.

TURN OFF VEHICLE AIR CONDITIONING.

IF THE ENGINE IS EQUIPPED WITH AN ENGINE BRAKE OR RETARDER, DEACTIVATE IT.

DEACTIVATE ALL DEVICES INSTALLED ON THE ENGINE OR VEHICLE WHICH ALTER THE NORMAL ACCELERATION CHARACTERISTICS OF THE ENGINE AND HAVE THE EFFECT OF TEMPORARILY LOWERING SNAP-ACCELERATION TEST RESULTS, OR PREVENTING THE TEST FROM BEING SUCCESSFULLY COMPLETED.

v   For all vehicles:

DISPLAY PROMPT:

VERIFY THE SPEED-LIMITING CAPABILITY OF THE ENGINE GOVERNOR, AND CHECK THE VEHICLE FOR BLUE OR WHITE SMOKE IN THE EXHAUST. BLUE SMOKE CAN BE AN INDICATOR OF UNBURNED HYDROCARBONS (POSSIBLE OIL BURNING OR MALFUNCTIONING NOZZLE), AND WHITE SMOKE CAN BE AN INDICATOR OF WATER VAPOR (POSSIBLE INTERNAL COOLANT LEAKING CONDITIONS).

PRESS "ESC" TO ABORT THE TEST IF ENGINE GOVERNOR IS NOT EFFECTIVELY LIMITING THE SPEED, OR IF BLUE OR WHITE SMOKE IS PRESENT IN THE EXHAUST.

2   Preliminary Snap-Acceleration Test Cycles

The vehicle shall receive at least three preliminary snap-acceleration test cycles (defined below) using the Snap-Acceleration Cycle sequence. The preliminary cycles allow the vehicle operator to become familiar with the proper throttle movement, and also to remove any loose soot, which may have accumulated in the vehicle exhaust system during prior operation.

If smoke measurements are made during the preliminary cycles, the preliminary cycles can also provide the opportunity to check for proper operation of the smoke measurement system, and to check if the test validation criteria can be met. In this case, the data-processing unit and the smokemeter zero and full scale should first be set according to the Data Processing Unit Setup section and the Smokemeter Zero and Full Scale (opacity calibration section).

3   Snap-Acceleration Cycle

i   The analyzer shall instruct the operator to move the throttle to the fully open position as rapidly as possible.

ii   The operator shall be instructed to hold the throttle in the fully open position, until the time the engine reaches its maximum governed speed, plus an additional 1 to 4 seconds.

iii   Upon completion of the 1 to 4 seconds with the engine at its maximum governed speed, the analyzer shall

prompt the operator to release the throttle and allow the engine to return to the low idle speed.

iv   Once the engine reaches its low idle speed, the operator shall be instructed to allow the engine to remain at idle for a minimum of 5 seconds, but no longer than 45 seconds, before initiating the next snap-acceleration test cycle.

Note: The time period at low idle allows the engine's turbocharger (if so equipped) to decelerate to its normal speed at engine idle. This helps to reduce the smoke variability between snap-acceleration cycles.

v   Steps (i) through (iv) shall be repeated as necessary to complete the preliminary snap-acceleration cycles.

4   Snap-Acceleration Test Cycles

Within 2 minutes of the execution of the preliminary snap-acceleration cycles, the analyzer shall instruct the inspector to conduct three snap-acceleration test cycles, actuating the vehicle throttle in the manner and sequence described in the Snap-Acceleration Cycle section.

The analyzer shall determine the corrected maximum 0.5 seconds average smoke values for each of the three snap-acceleration cycles.

At the conclusion of the test sequence, and where needed as per manufacturer's recommendation, the analyzer shall determine the degree of smokemeter zero shift by eliminating all exhaust from between the smokemeter light source and detector and noting the smokemeter display.

5   Test Validation Criteria
The test results from the Snap-Acceleration Test Cycles shall be considered valid only after the following criteria have been met:

i   The post-test smokemeter zero shift values shall not exceed:

- +/- 2.0% opacity for smoke measurements made in opacity.

ii   The arithmetical difference between the highest and lowest corrected maximum 0.5 s average smoke values from the three test cycles shall not exceed:

- 5.0% opacity smoke measurements made in opacity.

6   Invalid Test

Should the smoke test data from the Snap-Acceleration Test Cycles not meet the test validation criteria, the analyzer shall initiate the following checks for possible causes of the invalid test results:

i   If the engine did not meet the operating temperature requirements, the inspector shall run the engine/vehicle under load for at least 15 minutes or until the vehicle oil and water temperature gauges indicate that normal engine operating temperatures have been achieved. The analyzer shall return to the Smokemeter Zero and Full Scale step and repeat the test sequence.

ii   If improper or inconsistent application of the vehicle throttle is suspected, the analyzer shall re-instruct the inspector as to the proper execution of the snap-acceleration test, especially the movement of the vehicle throttle. The analyzer shall then continue on with the procedure, and shall repeat the preliminary test cycles and the snap-acceleration test sequence while observing the behavior of the vehicle.

iii   The analyzer shall prompt the inspector to check the smokemeter, its installation on the tailpipe, and any support instrumentation for possible malfunctions. Once the inspector indicates corrections have been made, the analyzer shall return to the Preliminary Snap-Acceleration Test Cycles step, and repeat the test sequence.

iv   If the post-test smokemeter zero check was exceeded due to positive zero drift, the probable cause is soot accumulation on the smokemeter optics. The analyzer shall re-initiate the snap-acceleration test sequence, and while doing so, the smokemeter zero may be readjusted during the low idle period between each of the snap-acceleration test cycles. If the measured low idle smoke level of the vehicle is less than 2.0% opacity, it is permissible to re-zero the meter while it remains exposed to the vehicle exhaust. If the idle smoke level exceeds these limits, it is necessary to discontinue exposure to exhaust before rezeroing the meter.

It is not necessary to complete an invalid test before employing the rezeroing technique discussed

previously. If comparison of the low idle smoke readings shows an increasing trend from one test cycle to the next, sooting of meter optics can be suspected and the rezeroing technique can immediately be used.

v   If it is not possible to rezero the meter, the analyzer shall prompt the inspector to clean the meter optics per the smokemeter manufacturer's recommended procedures. The test sequence shall then be repeated, beginning with preliminary snap-acceleration test cycles. If zero drift and re-zeroing difficulties persist, the analyzer shall recommend to the inspector that the meter purge air system (if so equipped) be checked for proper operation.

vi   If the procedure has been repeated in accordance with the requirements stated in INVALID TEST criteria above, and test results still cannot be obtained that conform with the test validation criteria, then the analyzer shall display a prompt stating that it is likely the engine is in need of service.

7   Calculation and Reporting of Final Test Result

If the test validation criteria are met, the data shall be deemed valid and the test complete. The average of the corrected maximum 0.5 seconds average smoke values from the three snap-acceleration test cycles shall be computed and reported as the final test result.

8   Storage

The emission values from the first test shall be stored in a manner determined by the analyzer software until a pass/fail decision on the emissions values has been determined. If the emissions indicate a pass, the values from the first test shall be written to the Diesel Heavy Duty Final Results fields of the TEST.DAT file, and the 1st Chance(If Applicable) fields shall remain blank.

If preconditioning and a second chance emissions test is given, the second chance emissions values shall be written to the Diesel Heavy Duty Final Results fields of the TEST.DAT file. The results of the first test, shall be written to the 1st Chance(If Applicable fields of the TEST.DAT file.

If the results indicate a passed test, according to the cut points in DSLSTD.DAT, "P" shall be recorded in the Diesel

Test Result field of TEST.DAT. Otherwise, "F" shall be recorded.

c   Non-Loaded Diesel Test Procedure

1   VEHICLE PREPARATION AND SAFETY CHECK

The system shall prompt the operator to perform the following functions:

i   Prior to beginning the test, a smokemeter zero and full scale shall be performed, per the Calibration section. Some meter systems may automatically perform the zero and full scale checks. For other meters, this sequence will need to be done manually.

ii   For vehicles with manual transmissions:

DISPLAY PROMPT:

PLACE THE TRANSMISSION IN NEUTRAL AND RELEASE THE CLUTCH.

iii   For vehicles with automatic transmissions:

DISPLAY PROMPT:

PLACE TRANSMISSION IN THE PARKED POSITION, IF AVAILABLE. IF NOT AVAILABLE, PLACE IT IN THE NEUTRAL POSITION, WITH MAXI OR PARKING BRAKE APPLIED.

iv   For all vehicles:

DISPLAY PROMPT:

CHECK VEHICLE WATER AND OIL TEMPERATURE GAUGE TO VERITY THAT THE ENGINE IS WITHIN ITS NORMAL OPERATING TEMPERATURE RANGE.

CHOCK WHEELS AND RESTRAIN VEHICLE.

TURN OFF VEHICLE AIR CONDITIONING.

IF THE ENGINE IS EQUIPPED WITH AN ENGINE BRAKE OR RETARDER, DEACTIVATE IT.

v   For all vehicles:

DISPLAY PROMPT:

CHECK THE VEHICLE FOR BLUE OR WHITE SMOKE IN THE EXHAUST. BLUE SMOKE CAN BE AN INDICATOR OF UNBURNED HYDROCARBONS (POSSIBLE OIL BURNING

OR MALFUNCTIONING NOZZLE), AND WHITE SMOKE CAN BE AN INDICATOR OF WATER VAPOR (POSSIBLE INTERNAL COOLANT LEAKING CONDITIONS).

PRESS "ESC" TO ABORT THE TEST IF BLUE OR WHITE SMOKE IS PRESENT IN THE EXHAUST.

2   Diesel Idle Cycle

   i   The analyzer shall instruct the operator to run the vehicle for 30 seconds at idle.

   ii   The analyzer shall determine the corrected maximum 0.5 second average smoke values, as measured during seconds 20-30 of the 30 second period

   iii   Upon completion of the 30 seconds at idle, the analyzer shall prompt the operator to turn off the vehicle.

   iv   At the conclusion of the test sequence, and where needed as per manufacturer's recommendation, the analyzer shall determine the degree of smokemeter zero shift by eliminating all exhaust from between the smokemeter light source and detector and noting the smokemeter display.

3   Test Validation Criteria
The test results from the Diesel Idle Test Cycles shall be considered valid only after the following criteria have been met:

   i   The post-test smokemeter zero shift values shall not exceed:

   - +/- 2.0% opacity for smoke measurements made in opacity.

   ii   The arithmetical difference between the highest and lowest corrected maximum 0.5 second average smoke values from the test cycle shall not exceed:

   - 5.0% opacity smoke measurements made in opacity.

4   Invalid Test

Should the smoke test data from the Non-Loaded Diesel Test Cycle not meet the test validation criteria, the analyzer shall initiate the following checks for possible causes of the invalid test results:

i   If the engine did not meet the operating temperature requirements, the inspector shall run the engine/vehicle under load for at least 15 minutes or until the vehicle oil and water temperature gauges indicate that normal engine operating temperatures have been achieved. The analyzer shall return to the Smokemeter Zero and Full Scale step and repeat the test sequence.

ii The analyzer shall prompt the inspector to check the smokemeter, its installation on the tailpipe, and any support instrumentation for possible malfunctions. Once the inspector indicates corrections have been made, the analyzer shall return to the Diesel Idle Cycle, and repeat the test sequence.

iii If the post-test smokemeter zero check was exceeded due to positive zero drift, the probable cause is soot accumulation on the smokemeter optics. The analyzer shall re-initiate the diesel idle test sequence, and while doing so, the smokemeter zero may be readjusted during the low idle period before diesel idle test cycle. If the measured low idle smoke level of the vehicle is less than 2.0% opacity, it is permissible to re-zero the meter while it remains exposed to the vehicle exhaust. If the idle smoke level exceeds these limits, it is necessary to discontinue exposure to exhaust before rezeroing the meter.

    It is not necessary to complete an invalid test before employing the rezeroing technique discussed previously. If comparison of the low idle smoke readings shows an increasing trend from one test cycle to the next, sooting of meter optics can be suspected and the rezeroing technique can immediately be used.

iv If it is not possible to rezero the meter, the analyzer shall prompt the inspector to clean the meter optics per the smokemeter manufacturer's recommended procedures. The test sequence shall then be repeated. If zero drift and re-zeroing difficulties persist, the analyzer shall recommend to the inspector that the meter purge air system (if so equipped) be checked for proper operation.

v   If the procedure has been repeated in accordance with the requirements stated in INVALID TEST criteria above, and test results still cannot be obtained that

conform with the test validation criteria, then the analyzer shall display a prompt stating that it is likely the engine is in need of service.

5   Calculation and Reporting of Final Test Result

If the test validation criteria are met, the data shall be deemed valid and the test complete. The corrected maximum 0.5 second average smoke values, from seconds 20-30 of the 30-second test cycle, shall be computed and reported as the final test result.

6   Storage

The emission values from the test shall be stored in a manner determined by the analyzer software until a pass/fail decision on the emissions values has been determined. If the emissions indicate a pass, the values from the first test shall be written to the Diesel Non-Loaded Final Results fields of the TEST.DAT file.

If preconditioning and a second chance emissions test is given, the second chance emissions values shall be written to the Diesel Non-Loaded Final Results fields of the TEST.DAT file. The results of the first test shall be written to the Non-Loaded 1st Chance(If Applicable) fields of the TEST.DAT file.

If the results indicate a passed test, according to the cut points in DSLSTD.DAT, "P" shall be recorded in the Diesel Test Result field of TEST.DAT. Otherwise, "F" shall be recorded.